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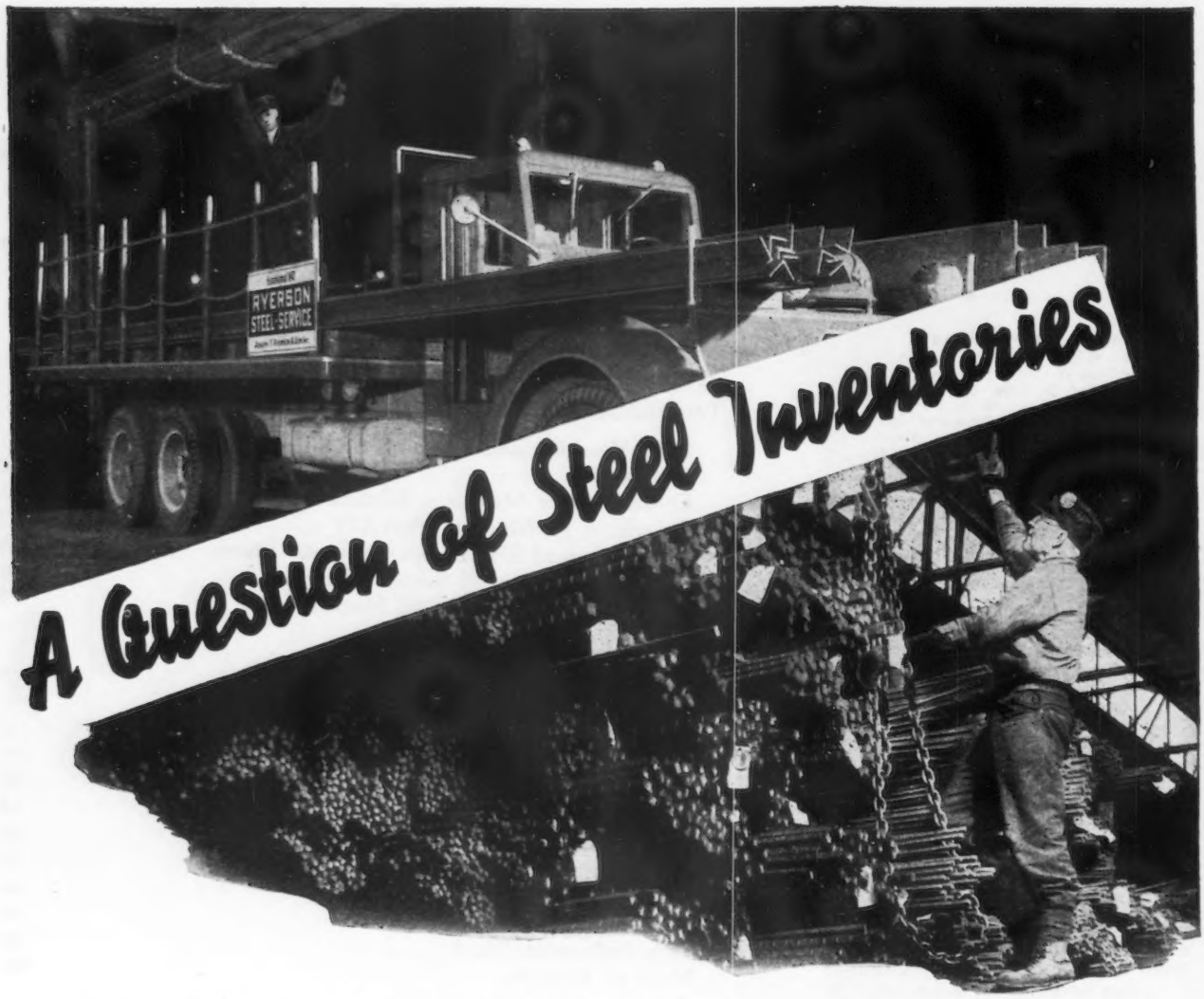

A Question of Steel Inventories

When cancellations are issued and cutbacks ordered will your steel inventory be too high? If so your excess stock may prove unsuited for quick conversion to other production, and decline sharply in value. By lowering your inventory you can help reduce the overall tonnage of idle steel.

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We suggest, therefore, that you check your steel inventory, and then talk with a Ryerson representative. A large reserve may be necessary. On the other hand you may find your inventory can be cut, and that you can protect yourself against disposal of an overstock at a sacrifice.

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Face Saving in Washington

THE more I reflect upon the apparent desire of some of our national leaders to imitate the Japs by adopting their practice of "face saving," the more I become convinced that the "monkey men" must have something on the ball. Heretofore, we thought that Americans were originators and the Japs were imitators; going so far indeed as to actually reproduce blow-hole plugs in the castings of our machines which they copied.

I still believe that our American engineers and industrialists have enough originality in thought and action to maintain their leadership without copying the Japs, but evidently our War Labor Board members have not. For their award to labor in connection with the controversial "Little Steel Formula" is a perfect example of face saving. More than that it is an example of chicanery of the highest, or perhaps I should say lowest, order.

Setting themselves up as defenders of the public against the encroaching hordes of inflation, this body of administrators raised one hand and said: "You shall not pass." With the other hand, it pointed to a hole in the fence and said: "Crawl through that, boys, and you will find at least part of what you are after."

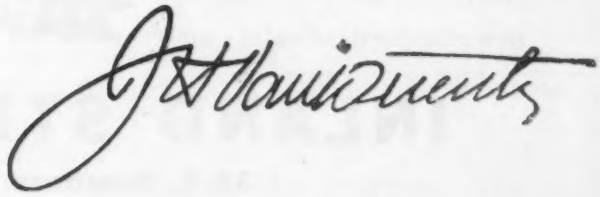
It would have been far more honest and open and far more in the American way of putting the cards on the table if these men had made a flat wage rise across the board. And that would have been much fairer to the public, to steel labor and to those who employ that labor.

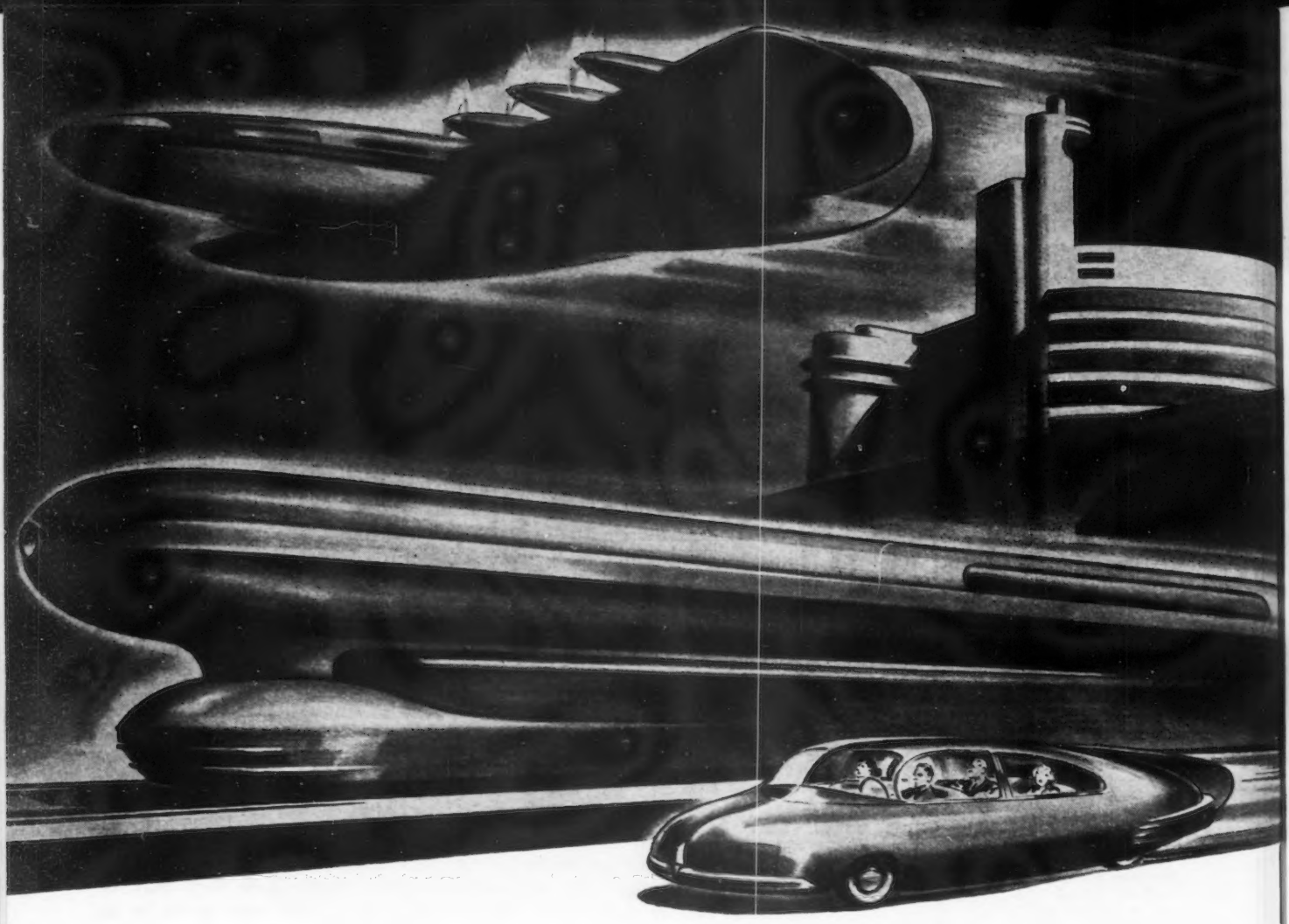
It would have been fairer to the public, because in the last analysis the public pays the bills for wage rises no matter how they may be disguised and regardless of whether they do or do not result in an increased price. Increases in cost of labor, being part of operating cost, come out of profit. And under the excess profits tax, 95c. of almost every dollar of steel profits now go to the government to help finance the war. The public will have to make up that difference between 95 per cent of the amount involved in the steel cost rise and the much lower revenue received from the individual steel worker who profits by it. In effect, steel employers deduct 95c. from taxes, pass them to steel worker, Jones, who returns 20c. to Uncle Sam to close the deal. Uncle Sam loses 70c. on the deal but needing the money, collects it from the general public.

It is not fair to steel labor since the rise is discriminatory. It penalizes the older workers who because of age and seniority have worked themselves into steady position on the day turn and cannot, therefore, collect for either overtime or night shift work.

It penalizes the steel employer because it imposes a tremendous accounting burden which will keep the presently undermanned staffs working for months to come, going over shift time cards back to the retroactive date to determine who worked on each shift, how long and how much each man has coming to him. Furthermore with the overlapping shift system in vogue to solve transportation difficulties, it will be hard to determine when the day shifts end and the night shifts begin.

Face saving is generally an expensive thing, and it is too bad that our War Labor Board is establishing it as an American practice.





Better Steels are Coming— from the Tests of War

Hour after hour, month after month, Inland metallurgists study not only the needs for this war of steel, but also the requirements of a victorious America—the America that will turn again to peacetime developments in the crafts, and in the sciences—new developments that will prove again that free peoples set the pace for others to follow. Coming out of the tests of war are finer steels—steels that will set new standards of safety and speed in transportation. Steels that will help bring the newest advancements in swift communications into most homes in the land. Steels that will bring new conceptions of beauty, convenience, comfort, and utility—all at prices that can be afforded by the average American. Yes, you can look forward to the day when steel from Inland, now flowing 100 per cent into war products, will help build a greater America.

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NEWS FRONT

► Automobile manufacturers in forecasting the price of passenger cars estimate a 20 per cent increase over prewar prices for materials alone. Because of the application of extras, for example, steel prices are up anywhere from 11 to 27 per cent.

Another major increase in costs is in labor which is up about 30 per cent. The combination of labor and material price increases, therefore, is somewhere around 20 per cent in the wholesale price of an automobile. It is doubtful whether OPA will allow such a price rise.

► Strikes and labor shortages have been blamed for every war shortage, actual or potential, over the past several years, but current lack of artillery and mortar ammunition is traceable primarily to lack of proper estimation of future needs.

Army officials are being criticized for this lack of vision, but as late as a year ago most observers could not visualize such a return to close-quarter slugging as now holds sway. Up to a year ago industry spokesmen were privately wondering if the then very large stocks of shells would ever be used.

► The new bombsight used on Superfortresses makes the once-super-secret Norden bombsight appear very inaccurate. The new bombsight actually (not just in publicity handouts) permits pin-point bombing from 30,000 ft. However: A major deterrent for such pin-point bombing is that when bomb bays are opened for the bomb-run, the inrush of frigid air cools all the various sizes of control cables thereby throwing the automatic pilot far off pre-set sights.

To conquer this the steel industry has just developed a steel control cable with the same coefficient of expansion as aluminum alloy, thereby eliminating differentials in expansion and contraction between the cables and the airframe.

► The Hughes (originally with Kaiser) super-publicized flying boat is ready for trial runs. A plywood job (the hull is 16 plies), it has twice the wingspread of a Superfortress. At Culver City it will have to be dismantled for transfer to seaside.

► The Elliott Co., Jeanette, Pa., has completed the first gas turbine marine motor made in this country. It delivers 2000 net hp. and is very compact. Gas turbines which take off all power mechanically promise wide application in railway and marine applications. Such motors are very similar to jet motors for aircraft, although the latter uses all net power as a jet rather than mechanically.

Most aircraft of the future will likely use a gas turbine with part of the power taken off mechanically for a propeller and the remainder of the power employed as a jet.

► Industries in the Pacific Northwest, the region noted for its huge electric power generators, are finding themselves rationed in the amount of electric current they may use.

There is no shortage of power, however, but only a squeeze where private power companies are reluctant to purchase more from Bonneville than their power pool commitment.

► The Tacoma Narrows bridge, the one that blew down in a windstorm four years ago will be rebuilt when materials and labor are available. The Pierce County (Tacoma) Toll Bridge Authority recovered $4,000,000 from insurance and salvaged $250,000 more. It has $3,200,000 in remaining assets including anchorages, approaches and other piers. The loss at the time of its failure was estimated at $6,500,000.

► Of the 2430 terminations valued at $2,763,000,000 in process with the Navy on Nov. 1, some 274 contractors whose terminations involved $2,333,000,000 had filed no claims. Largest cuts in the Navy program have come in the destroyer escort program although terminations in submarines, torpedoes and 20 mm. guns and ammunitions have been substantial. The only programs of the Navy which are lagging are rockets and 40 mm. ammunition.

► China's wide-eyed friends who are beating the drum for a huge industrialization program immediately following the war are losing sight of the complicated problems involved in such a plan.

Not only is the complicated political situation a deterrent to its industrialization, but the Japanese conquest of some of China's most productive regions, the lack of transportation and skilled labor combine to force a conclusion that the job of even partially industrializing China is one far beyond the comprehension of most Western people.

. . . Cold Working and Forming of

By R. G. SARTORIUS
Metallurgist and Engineer of Test, National Lock Washer Co., Newark, N. J.

THE experience of National Lock Washer Co. with silicon-manganese steel for spring washers for industrial and railway use goes back to the year 1931, at which time the writer was still connected with an eastern steel company.

The material produced by the steel company for lock washers was hot-rolled shapes, roughly equivalent in size to ¼ in. to ½ in. rounds. Depending on chemical analysis, size, finishing temperature and cooling rate, the as-rolled hardness was found to vary between 265 and 305 Brinell.

Knowing that in the process of manufacture the steel had to undergo rather severe cold working such as coiling around an arbor, severing (shearing), and in some cases even forming, it was only natural to assume for both supplier and consumer that this hardness was too high.

The first and most logical step, therefore, was to try to anneal the steel. From previous experience with different grades of spring steel for the same application, annealed structures showing but small percentages of lamellar pearlite were not even considered. The aim of the steel company was to obtain maximum softness together with a completely spheroidal structure. In order to accomplish this, at that time generally accepted annealing methods were tried, i.e. (1) "prolonged heating at a temperature just below the lower limit of the transformation temperature range with subsequent slow cooling (2) heating to a temperature above the transformation range and then, after holding a suitable time, cooling very slowly in the furnace."[1]

A hardness of 200 to 210 Brinell and a coarsely spheroidized structure were readily obtained. However, much to the disappointment of everybody concerned, the steel thus annealed (spheroidized) was found to be extremely brittle and entirely unsuitable for any cold-working operations.

Evidently, as might have been expected with a 2 per cent silicon steel, the long annealing cycles had caused graphitization.

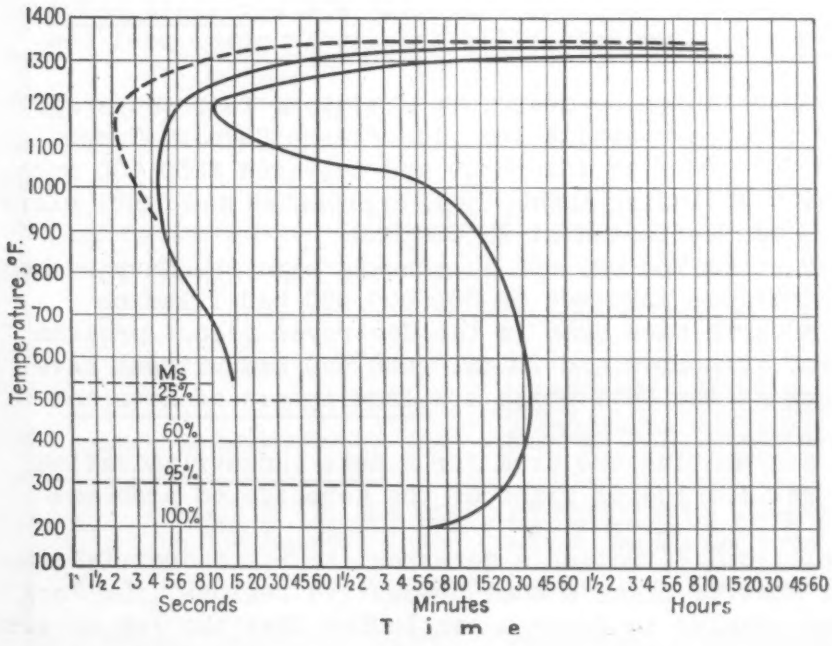
All further attempts to produce satisfactory ductility by annealing were abandoned and for the years following, silicon-manganese spring steel shapes were ordered and supplied in the natural, i.e. hot-rolled condition.

This was the status when, in 1937 the writer became associated with the National Lock Washer Co. It was soon realized that ordering this grade of steel to a certain chemical specification and a maximum hardness of 285 Brinell desired, was no assurance for its satisfactory performance with regard to cold-working. Particularly during the winter months it seemed that breakage in coiling of certain bundles of steel was most prevalent. The problem of coiling was thus attacked first since it resulted in lower production and an increase in manufacturing cost.

As is the case with quite a few corrosion and heat-resisting steels (high-silicon valve steel), heating to only moderate temperatures greatly improved the cold working characteristics of SAE 9260. After getting equipped with steam heated chambers holding approximately 5500 lb. of steel at a time and capable of bringing the hot-rolled shapes uniformly to an elevated temperature of 130 deg. to 180 deg. F., no further difficulties were experienced with breakage in coiling. Severing (shear cutting) also was greatly facilitated by performing this operation immediately after coiling and while the steel was still hot.

As pointed out previously, only a small percentage of the material received would give any trouble in processing. Therefore, assume that a certain lot of steel could be coiled and severed cold but that—through the cumulative effect of cold working—it became too brittle for forming. In this case, a second "conditioning treatment" to restore ductility was found to apply. Heating over a wide

ISOTHERMAL transformation diagram for SAE 9260. Austenitizing temperature, 1650 deg. F.; critical (AC_1) temperature, 1380 deg. F.; prior condition, as-rolled. Steel analysis: 0.57 C, 0.72 Mn, 1.89 Si, 0.20 Ni, and 0.11 Cr. Courtesy Eastern Research Laboratory, Crucible Steel Co. of America.



Silicon-Manganese Spring Steel . . .

temperature range of, say, 1100 deg. to 1300 deg. F. and quenching in air or water would "recondition" the steel entirely or to such a degree that cold forming could be done without any danger of cracking. This treatment might best be called a stress relief since it does not result in any change in hardness or microstructure.

Finally, the hope of annealing (spheroidizing) this grade of steel without graphitization was never given up entirely. When P. Payson, Chief Research Metallurgist, Eastern Research Laboratory, Crucible Steel Co. of America, published his modern conception of annealing based on TTT curves[2], it was felt that here might be the answer to these problems. Following closely the underlying principles of Payson's work, the following three experimental cycles were arrived at:

(A) Heat to 1450 deg. F., hold for ¼ hr., cool fast to 1325 deg. F., hold for 2 hr., and air cool.

(B) Heat to 1450 deg. F., hold for ¼ hr., cool fast to 1325 deg. F., hold for 2 hr., cool fast to 1275 deg. F., hold for 1 hr., and air cool.

(C) Heat to 1325 deg. F., hold for 3 hr., raise temperature to 1450 deg. F., hold for ¼ hr., cool fast to 1325 deg. F., hold for 2 h., cool fast to 1275 deg. F., hold for 1 hr., and air cool.

. . . The full annealing without graphitization of silicon-manganese spring steels has resulted in definite advantages in the cold working and forming of this grade of steel.

While there was found to be a very little or no difference in hardness (212 Brinell) both cycles A and B showed an appreciable amount of elongated carbides; cycle C resulted in a completely and coarsely spheroidized structure and the steel thus annealed showed excellent cold-forming properties. As determined by chemical analysis any serious graphitization did not occur:[3]

	Graph. C
Hot-rolled	0.012
Annealed (Cycle C)	0.015

Annealing on a large scale proved equally successful.

Summarizing, it may thus be said that there are three ways in which to overcome any possible cold-processing difficulties that might be experienced with silicon-manganese spring steel:

(1) Heating to an elevated temperature (130 deg. to 180 deg. F.)

(2) Stress relieving (1200 deg. F., water quench).

(3) Full annealing.

Since, to the writer's knowledge, SAE 9255 (60) is widely used in the automotive as well as in the railroad field, it was felt that the experiences described herein might be of some benefit to many other industries. Full annealing without graphitization should be of interest to those engaged in cold-drawing or rolling of this grade of steel.

---

[1] *1942 preprint of the A.S.T.M. Report of Committee E-8.*

[2] *P. Payson, "The Annealing of Steel," a series of articles which appeared in* THE IRON AGE *during June and July 1943.*

[3] *C. R. Austin, Penn State College; and M. C. Fetzer, Carpenter Steel Co., "Factors Controlling Graphitization of Carbon Steels at Subcritical Temperature," Paper presented National Metal Congress, 1944.*

Dynamometer Measures Friction of Packings

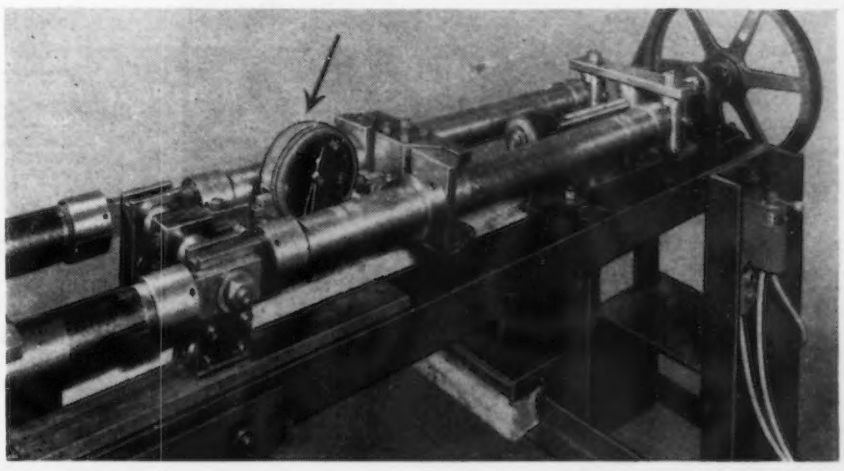
A CONVENIENT method for measuring the friction of hydraulic piston packings against the cylinder wall has been devised by inserting a Dillon traction dynamometer between the loading mechanism and the piston in a setup shown in the illustration.

A traction dynamometer was utilized by a leading manufacturer of aircraft equipment called upon recently to make tensile tests on the magnesium supporting structure of pilot's seats. Because of the odd size and shape of the units, a conventional testing apparatus could not be used. By mounting the seat to the floor and suspending a block and tackle from an overhead support, a Dillon dynamometer placed in series with the seat and block read the direct load in pounds that ultimately ruptured the magnesium supports.

These dynamometers have come into use in some steel plants as portable scales for weighing odd lots of steel, thereby saving the expense of a crane scale operator.

The instrument is manufactured by W. C. Dillon & Co., Inc., 5410 West Harrison Street, Chicago 44. It weighs 8 lb. 4 oz. and measures 8¼ x 6¼ x 3 in.

USING a Dillon traction dynamometer to measure the amount of friction encountered by the hydraulic piston packings against the cylinder wall.



Broaching vs. Milling

By I. A. SWIDLO
Head Engineer, Production Engineering Department, Springfield Armory

THE part of the Garand semi-automatic rifle called the "Handle, Operating Rod" is a slender component nearly 9 in. long, shown as a forging and a finished part in Fig. 9. To a conventionally minded process engineer it is an ideal example for milling machine method of manufacture, inasmuch as being narrow it requires comparatively short cuts. However, a careful study was made which revealed that the first 11 milling operations, previously adopted before any hope was entertained by the writer for new methods and for the procurement of new machine tools, could be combined into eight broaching operations.

With the exception of two for last two operations all broaching fixtures for this component are hydraulically operated and are equipped with electro contacts which interlock with the starting circuit of the machine in order to prevent possible down movement of the ram if the component is not properly located or clamped.

Since the component is long and slender it is very difficult to produce an absolutely straight forging economically so that the work could be supported at every point under the cut. Therefore it was found necessary to make the first operation a roughing cut, known as Operation 10, that of broaching bedding spots on the right hand side, as shown in Fig. 10. This is performed on the right hand ram of 5-ton, 54 in. Cincinnati duplex vertical surface broaching machine. The forging is located in the fixture endwise, stopping against a hardened block and supported at the rear end of the handle and underneath with hardened blocks in four places. There are two clamps which apply pressure at four points opposite to the supporting places. One clamp is equipped with a swivel jaw to compensate for irregularity in the forging.

The forging is made of WD 8745 steel, normalized to 217 Brinell hardness, with maximum stock to be removed of 0.169 in. The important part of this operation is to broach all locating pads in line so that the next cut will be properly supported. The chip load per tooth on the roughing broach teeth is 0.004 in. gradually decreasing to 0.001 in. on the finishing teeth.

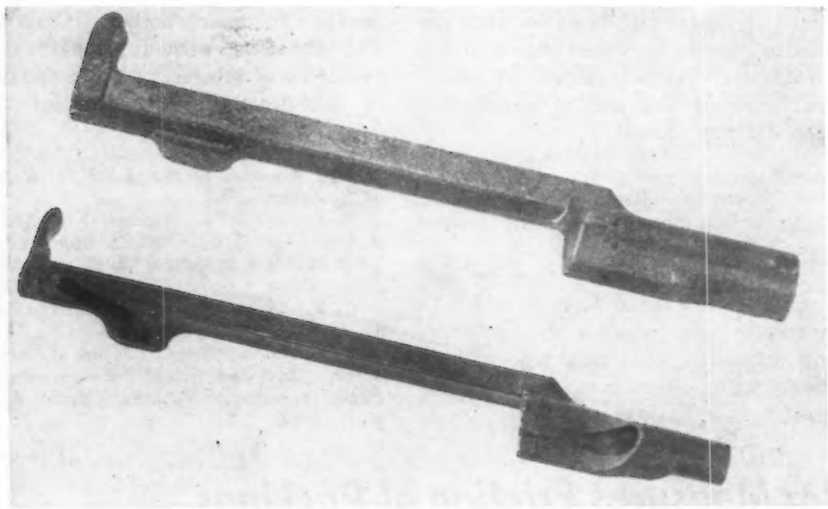
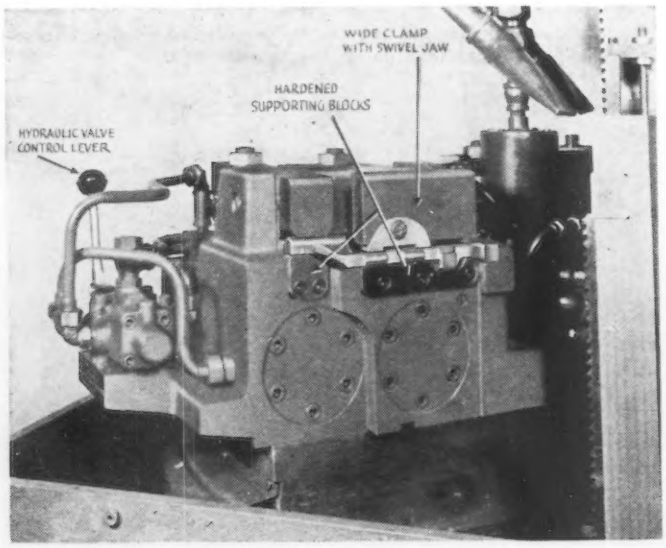


FIG. 9—Rough forging and finished operating rod handle for the Garand semi-automatic M1 rifle. An analysis of the machining of this component was chosen to illustrate tooling problems in broaching a long, slender part.



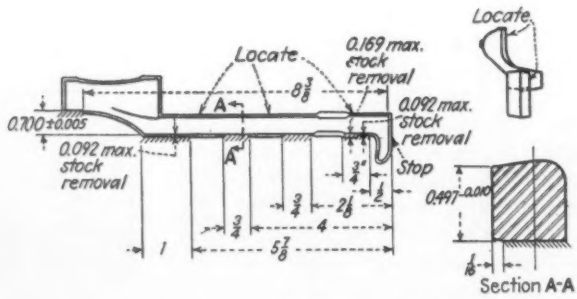


FIG. 10—First roughing cut on the operating rod handle is that of broaching bedding spots on the right hand side, designated as Oper. 10. Sketch shows the cuts to be made. Fixture is at left.

In Manufacturing Rifle Parts . . .

. . . In the second part of a five-part article, the author takes up the details of broach tooling for a long, slender part. Comparative data on milling operations to produce the same daily output are given.

The left hand table of the same machine is equipped with a fixture to hold the forging while Oper. 15, "broach left side, rear end and spots on tube section," is being performed. The sketch of the cut and a photograph of the fixture are shown in Fig. 11. The forging is located endwise from inside the finger bar and is supported and clamped in the same way as in the previous operation. It is backed up against the spots cut in Oper. 10.

The maximum amount of stock to be removed is 0.161 in., with chip load per tooth on the roughing inserts of 0.003 in.; middle inserts, 0.002 in., and third inserts, 0.0016 in. The finishing broach insert has a chip load of 0.001 in. up to the 14th tooth, with the balance of the teeth removing a chip only 0.0005 in. thick. In order to insure an acceptable finish and reduce possible chatter, the broad broach inserts have teeth with a 30 deg. shear angle. The forward and return speed of the ram is 35 ft. per min. with a 54 in. stroke, giving a production of 167 pieces per hr. Complete setup on the machine of both fixtures and broach holders for Oper. 10 and 15 is shown in Fig. 12.

In Fig. 13 is illustrated the fixture and the next cut, known as Oper. 20, "broach bottom side and tube section ends." The fixture is mounted on the left hand table of a second 5-ton 54 in. Cincinnati duplex vertical broaching machine (see Fig. 15). The part is *supported* in the fixture on surface broached on previous operation and is *located* against the same surfaces used to support the forging in the first operation. (Oper. 10). Two clamps apply pressure to hold the component securely in the fixture on spots broached in first operation.

The maximum stock to be removed from the rear end of the tube section is 0.192 in., and from front end, 0.168 in. Since the cut starts at this point on the trimmed edge, the chip load per tooth on the roughing broach inserts is 0.004 in., gradually decreasing to 0.001 in. on the finishing teeth. However, the broad broach inserts cutting the handle bar and removing only 0.060 in. of stock begins to cut a chip the full width of the component and therefore have a chip load on the roughing

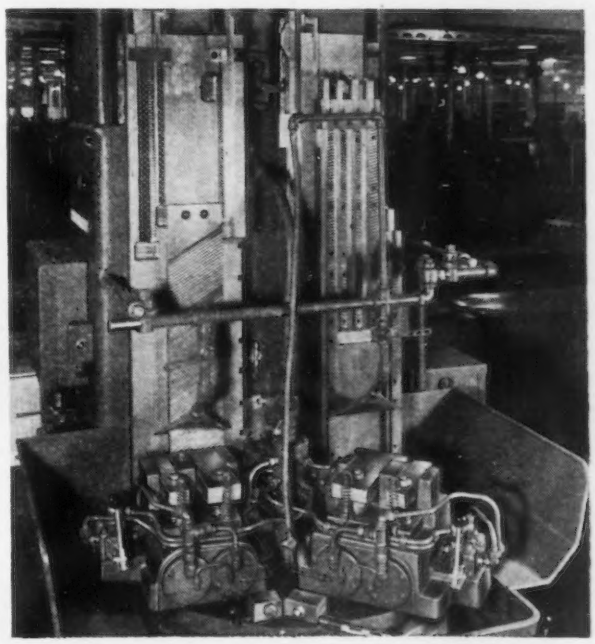


FIG. 12—The fixtures shown in detail in Figs. 10 and 11 in this view are mounted on the swiveling table of a 54 in. stroke duplex broaching machine. Oper. 10 is performed at the right; Oper. 15, at the left.

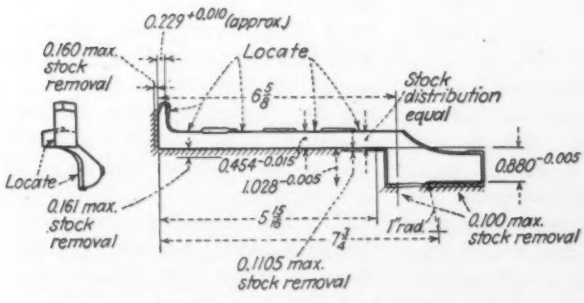
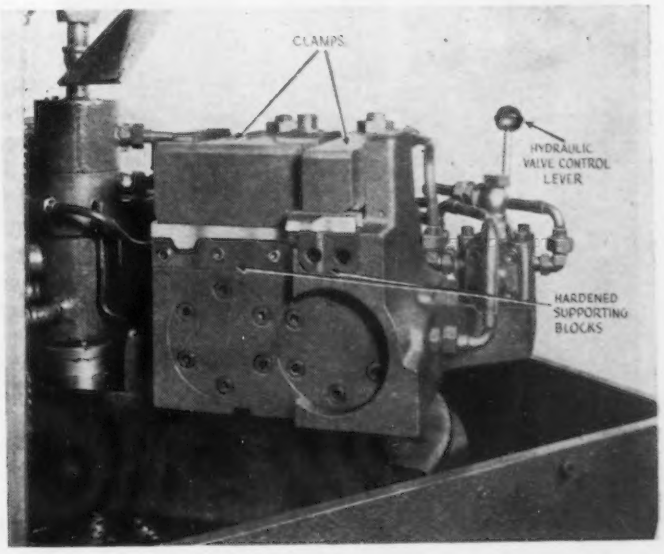
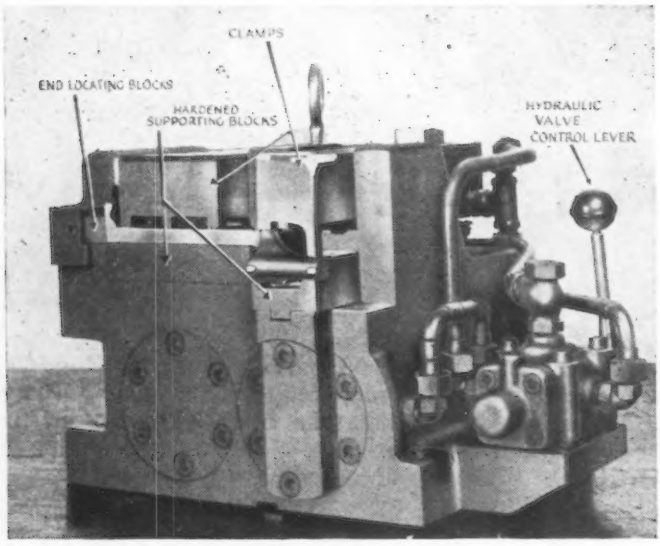


FIG. 11—Oper. 15 consists of broaching the left side, rear end and spots on the tube section of the operating rod handle.





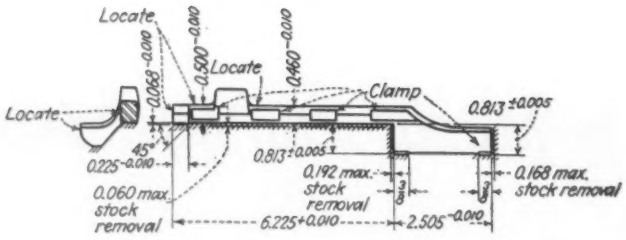


FIG. 13—The third operation, called Oper. 20, is performed in this fixture. The cut consists of broaching the bottom side and the tube section ends. This fixture is shown on the left of the table in Fig. 15.

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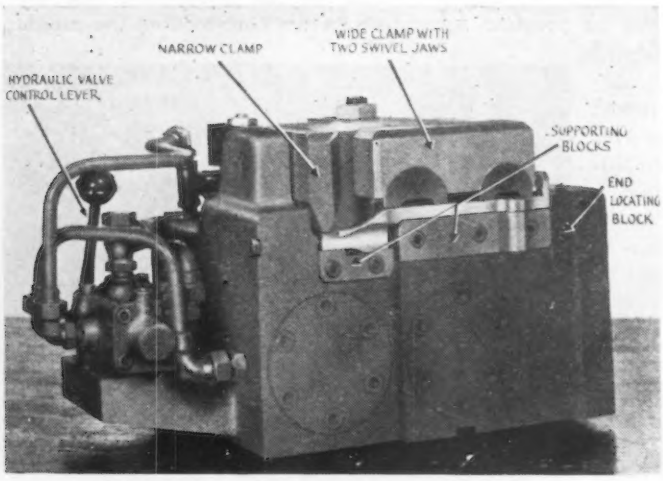


FIG. 14—The fourth broaching operation on the operating rod handle is performed on this fixture. The cut for Oper. 25 is that of broaching the top side and a 2 in. radius.

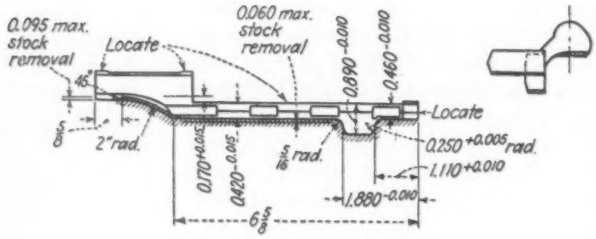
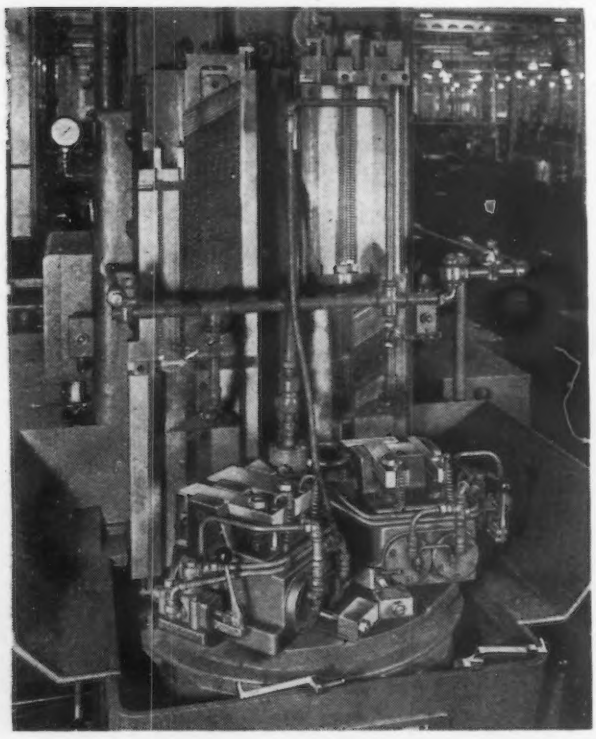


FIG. 15—Complete setup for performing Oper. 20 and 25 on a 54 in. vertical duplex broaching machine. Oper. 20 is accomplished with the tools and fixture on the left, Oper. 25, on the right.



insert of only 0.002 in., on the middle insert of 0.0015 in., and on the first 17 teeth of the finishing broach of 0.001 in., with the last seven teeth removing a chip 0.0005 in. thick. Since the component is comparatively narrow and is subject to a hammering effect, resulting in poor finish, these broad inserts that cut along the bottom side are given a 30-deg. shear angle (see Fig. 15).

The right hand table of the same machine is equipped with a fixture to hold the component while Oper. 25, that of broaching the top side and a 2 in. radius, is performed. This cut and the fixture are illustrated in Fig. 14. The component is located in the fixture endwise by the rear end of the finger bar and is supported on the surface broached by Oper. 15 (Fig. 11) and gaged against surfaces broached in the preceding operation. Two clamps, one a wide one with two swivel jaws, applies the pressure at the points broached in first cut.

The maximum stock to be removed is 0.060 in., and the chip load per tooth is as in preceding cut, that is, wide inserts cutting long surfaces have a chip load at the start of cut of 0.002 in., and the last 17 finishing teeth remove a chip 0.0005 in. thick. These teeth have 30 deg. shear angle for the same reason. The forward and return speed of the ram is 35 ft. per min., with a 54 in. stroke, giving a production of 167 pieces per hr. Complete setup on the machine of both fixtures and broach holders for Oper. 20 and 25 is shown in Fig. 15.

The last broaching operation on the long bar is known as Oper. 30, "broach right side, finger bar tip and spot on tube section," illustrated in Fig. 16, with fixture holding the component in place. This operation is really one of finishing the surfaces out on the first broaching operation for locating spots only, except that

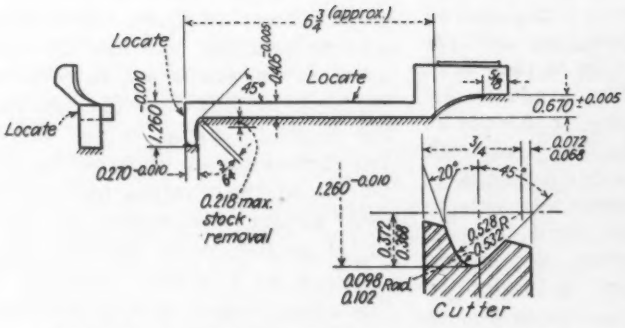


FIG. 16—The fifth broaching operation on the operating rod handle is known as Oper. 30, that of broaching the right side, finger bar tip and spot on the tube section. The fixture is mounted on the right of the table of the machine shown in Fig. 18.

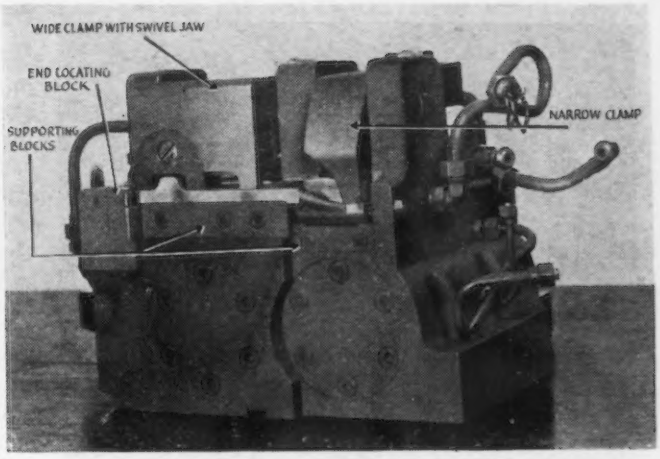


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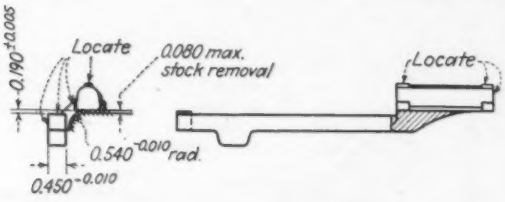
FIG. 17—The sixth broaching operation, known as Oper. 40, consists of broaching a 0.540 in. radius on the tube section. The fixture shown is mounted on the left of the table of the machine shown in Fig. 18.



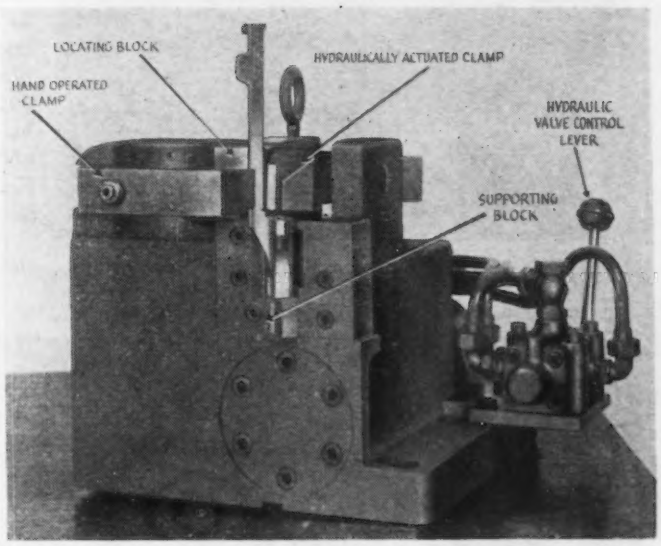
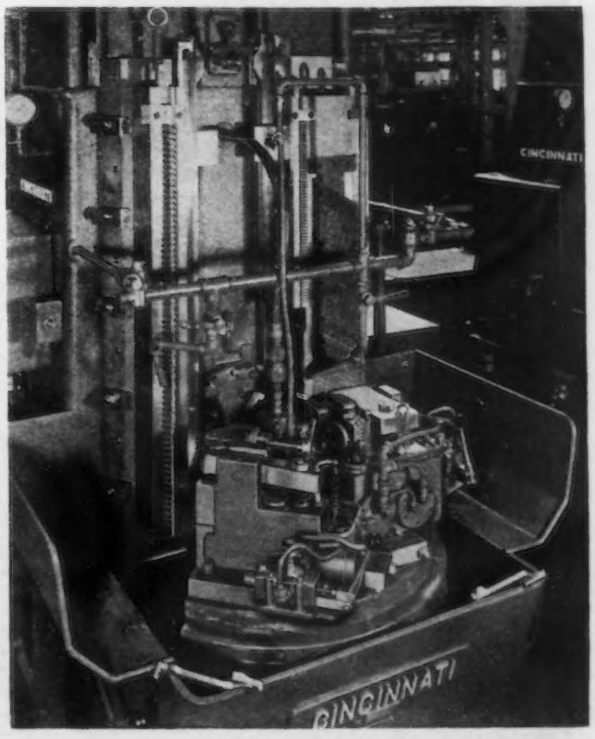


FIG. 18—Oper. 30 and 40 are performed on this 54 in. duplex broaching machine. The fixture for Oper. 30 is at the right, for Oper. 40 at the left.

the piece is inverted. (Compare with Fig. 10). The fixture is mounted on the right hand table of a third 5-ton, 54 in. Cincinnati duplex vertical broaching machine. The component is located in the fixture between stops endwise, supported on surfaces broached on Oper. 20 and gaged or located against surfaces broached on the cut shown in Fig. 11. Two clamps, one of which has a swivel jaw to compensate for variation in thickness of the handle bar, hold the component securely in the fixture.

Since this surface was partially broached in the first cut, the stock removal is not uniform and in some places as much as 0.218 in. has to be removed. The first roughing teeth strike a narrow surface where the forging was trimmed and since the surface consists of three spots approximately 1⅛ in. long to 0.160 in. deep, the chip load per tooth at the start of cut is 0.005 in. and gradually decreases to 0.002 in. up to this depth. From this point, the surface becomes approximately 6½ in. long and the chip load per tooth is reduced to 0.0015 in. at first, gradually decreasing to a 0.0005 in. chip removed by the finishing teeth. In this case of a wide cut, the shear angle on the broach inserts also is 30 deg.

The last broaching operation before the component is form milled and drilled in the tube section is known as Oper. 40, "broach 0.540 in. radius." The cut and fixture are shown in Fig. 17. As can be seen, the component is held in the fixture vertically, being located on two sides of the long bar and held by a horizontal, hand operated clamp. The tube section being broached is supported on previously broached locating points and is held down with a vertical, hydraulically operated clamp. This fixture is mounted on the left hand side of the table of the same machine used on the previous operation. (TURN PAGE)



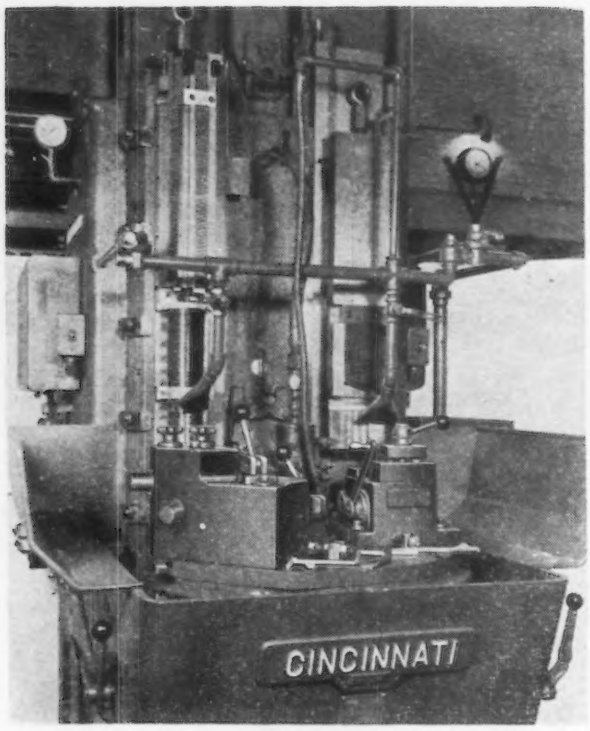
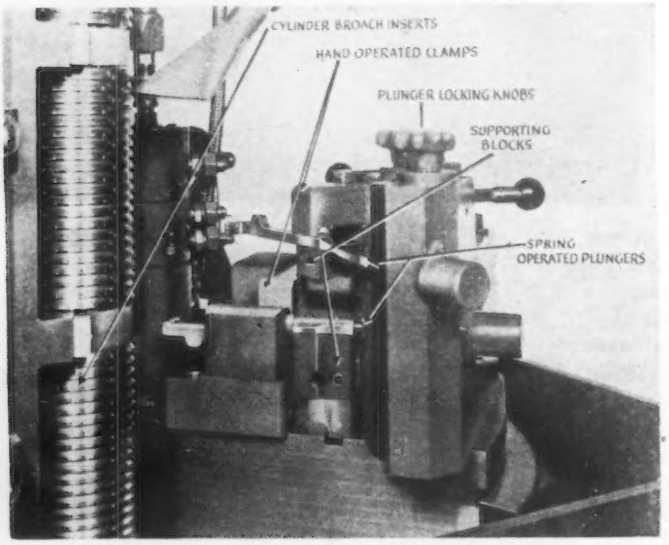
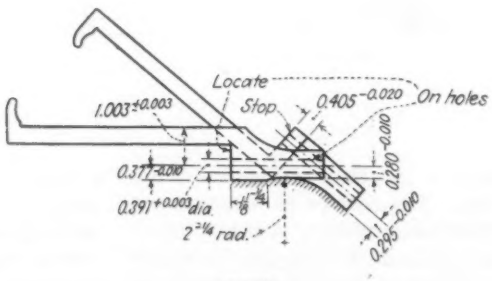


FIG. 21—Fixtures and broach holders for performing Oper. 65 (left) and Oper. 70 (right) are shown mounted on a 54 in. stroke duplex Hydro-Broach.

The maximum stock to be removed is 0.080 in., with a chip load on the roughing teeth at the start of the cut of 0.002 in., gradually decreasing to 0.0005 in. on the last five teeth of the finish broach. It is always advisable to remove small chips in broaching a concave surface in order to avoid breakage of teeth and secure a good finish. The forward and return speed of ram is 35 ft. per min. with 54 in. stroke, giving a production of 160 pieces per hr. The fixtures and broach holders for Oper. 30 and 40 are shown in Fig. 18 mounted on the machine.

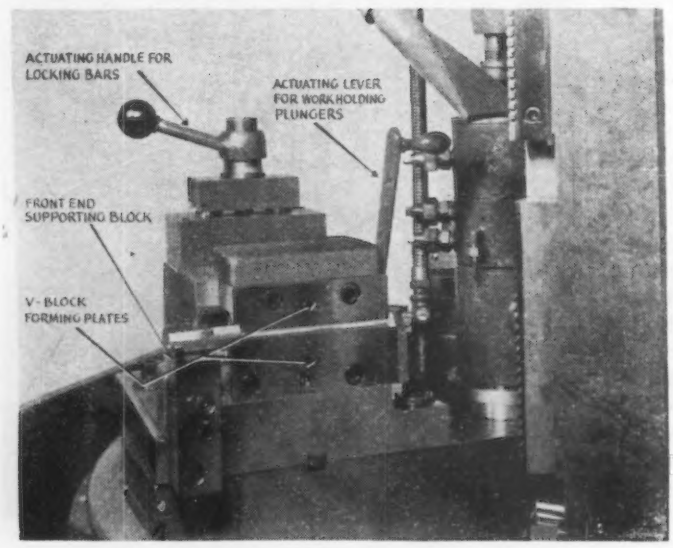
After the tube section of the component has been form milled and the 0.391 +0.003 in. diameter hole drilled, the piece is broached again. It is necessary to drill the hole first in order to locate the component on plugs as required by the drawing showing the location of the 2 in. radius. The broaching of this radius and 1⅛ in. of the straight part of the tube section, designated as Oper. 65, is performed on the left hand side ram of a fourth 5-ton, 54 in. Cincinnati duplex vertical broaching machine. The fixture is designed to hold two components, as shown with sketch of the cuts in Fig. 19. In each case the component is located on plugs and has support under each cut. The hand operated clamps hold the work on the bar section. The two spring operated plungers serve two purposes; first, they facilitate loading and unloading, and second, they hold the component against the rear end of the tube section, as a locating stop. These plungers are locked with knobs shown on the top





ABOVE

FIG. 19—Seventh broaching operation. Fixture and cuts for Oper. 65, broaching a 2 in. radius on the left side of the operating rod handle and a 1⅛ in. flat on the right side.


ACTUATING HANDLE FOR LOCKING BARS
ACTUATING LEVER FOR WORK HOLDING PLUNGERS
FRONT END SUPPORTING BLOCK
V-BLOCK FORMING PLATES

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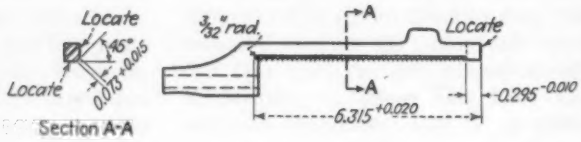
BELOW

FIG. 20—Eighth broaching operation. In broaching a 45 deg. chamfer and a 3/32 in. radius on the operating rod handle, this special fixture with V-block clamps is used. This is known as Oper. 70.



of fixture before the hand clamps are applied.

It is interesting to note that for machining the 2 in. radius, cylindrical broach inserts of four sections are mounted in the broach holder in the vertical ram. This type of broach insert is very economical as it cuts only with one-fifth of its circumference, and when one sector of arc becomes dull there is a provision made to revolve each section 70 deg.; therefore, the tool life of this type of broach is five times longer than a partial section of the radius. This design saves time in resetting of broach inserts after resharpening, besides simplifying the procedure of sharpening. The maximum amount of stock to be removed is 0.090 in. and the chip load per tooth on the roughing broach is 0.002 in., gradually decreasing to 0.0005 in. on the last seven teeth of the finishing broach.

The right hand side of the table of the same machine is equipped with a fixture to hold the operating rod handle while Oper. 70, "broach 45 deg. chamfer and 3/32 in. radius," is performed. The cut and fixture are shown in Fig. 20. The component is located endwise from the rear end finger bar and is held between two V-block plates actuated by two plungers operated by hand lever, shown at the right in the photo, through pinions and racks. Both plungers, after pressing the work into the V's, are locked by the tapered ends of two round bars clamped by hand, as can be seen on top of the fixture. This operation is quite simple and does not require further comment, except to state that the amount of material to be removed at the location of the 3/32 in. radius is nearly 7/32 in. and a smooth surface is required as this section is subject to a hammering, alternate load and any tool marks or tears are the beginning of fatigue cracks.

The forward and return speed of the ram is 35 ft. per min. with 54

TABLE II

Comparative Table of Broaching vs. Milling of the Operating Rod Handle of the Garand Semi-Automatic M1 Rifle

BROACHING					MILLING				
Description of Operation	Machine Used	Net Pcs. Per Hr.	No. Mach. Req'd. to Produce 1000 Pcs. Per 8 Hr.	No. Opers. Req'd. to Produce 1000 Pcs. Per 8 Hr.	Description of Operation	Machine Used	Net Pcs. Per Hr.	No. Mach. Req'd. to Produce 1000 Pcs. Per 8 Hr.	No. Opers. Req'd. to Produce 1000 Pcs. Per 8 Hr.
Oper. 10—Broach bedding spots on right hand side	5-54 in. Cincinnati duplex vertical broach	167	1	1	Oper. 1—Rough mill left side	No. 12 B&S miller	36	4	2
					Oper. 5—Finish mill left side rear, tube section and finger bar	3-24 in. Cincinnati Hydromatic	24	6	2
Oper. 15—Broach left side, rear end and spots on tube section	Same	167							
Oper. 20—Broach bottom side and tube section ends	5-54 in. Cincinnati duplex vertical broach	167	1	1	Oper. 4—Mill bottom side and tube section ends	3-24 in. Cinncinnati Hydromatic	24	6	2
Oper. 25—Broach top side and 2 in. radius	Same	167			Oper. 6—Finish mill top side	3-24 in. Cincinnati Hydromatic	36	4	2
					Oper. 14—Profile radius on tube section	No. 12 P&W profiler	65	2	2
Oper. 30—Broach right side, finger bar tip and spot on tube section	5-54 in. Cincinnati duplex vertical broach	160	1	1	Oper. 2—Rough mill back of cam and finish mill right side	2-18 in. Cincinnati millers	38	4	2
Oper. 40—Broach 0.540 in. radius	Same	160			Oper. 6B—Straddle mill end of tube section	No. 000 B&S miller	65	2	1
					Oper. 8A—Rough mill 0.550 in. radius	No. 12 B&S miller	70	2	1
					Oper. 9—Finish mill 0.550 in. radius	No. 12 B&S miller	65	2	1
Oper. 65—Broach 2 in. radius on left side and right side	5-54 in. Cincinnati duplex vertical broach	142	1	1	Oper. 12—Profile radius on left and right sides of tube section	No. 12 P&W profiler	50	3	3
Oper. 70—Broach 45 deg. chamfer and 3/32 in. radius	Same	142			Oper. 27—Mill 0.05 in. x 45 deg. land	1-12 in. Cincinnati miller	75	2	1

in. stroke, however, since one fixture, double type, requires two loading and unloading with two manually operated handles and two knobs to handle, the net production per hour is much lower in comparison with previous cuts, but reached 142 pieces. Fixtures and broach holders for Oper. 65 and 70 are shown in Fig. 21.

In Table II is given a comparative summary of broaching vs. milling operations on the operating rod handle, indicating the machine used, production per hour, number of machines and operators required to produce 1000 parts in 8 hr. As can be seen from this table there are only four broaching machines and four operators required. If milling methods were retained, however, then 37 milling machines and 19 operators would be required to do the same amount of work in the 8 hr. Since Springfield Armory operates on three shifts, three times as many operators would have to be employed, namely 57 as against 12.

[In the third article, Mr. Swidlo will illustrate the fixture designs for broaching a forging that is hollowed out to a mere shell and will give comparative performance data for milling the same piece.]

New Design of Side Blown Converter Plants

At the time of the expansion of converter plants in Great Britain, the supply of ores suitable for the manufacture of hematite irons suddenly became precarious. It became necessary to reassess the relative importance of the silicon and carbon reactions in the process. P. C. Fassotte reported to the British Iron and Steel Institute the results of experiments on the combustion of low silicon irons and the operation of a newly designed side-blown converter plant.

In view of the small amount of silicon contained in the irons used in these experiments, the temperature increments of over 350 deg. F. obtained could only be explained by the fact that the carbon combustion was essentially a carbon dioxide reaction. In this respect, the side-blown converter appears to work differently from the bottom-blown type where the passage of gases through layers of metal rich in carbon favors the production of carbon monoxide.

The function of the silicon reaction now appears in its true perspective. It is essentially a kindling agent. Its principal purpose in side-blown converter practice is to make up the difference between the temperature of the iron introduced into the converter and the temperature at which the carbon reaction starts freely.

The experimental work warranted the following conclusions:

(1) In the side-blown converter the bulk of the carbon is transformed into carbon dioxide, provided there is adequate blast volume.

(2) Irons containing from 2.7 per cent of carbon upwards, with only a negligible silicon content, can produce a temperature increment of over 390 deg. F.

(3) The carbon dioxide reaction is capable of making up the difference between an iron temperature of, say, 2642 deg. F. and the steel temperature required by the steel foundry.

(4) Silicon in the iron can be dispensed with, provided the metal is sufficiently hot the beginning of the blow.

It is a well known fact that the affinity of carbon for oxygen increases with temperature and becomes particularly pronounced at temperatures exceeding 2642 deg. F. If, therefore, iron were supplied to the converter sufficiently hot for the carbon reaction to start immeditely, then silicon could be dispensed with, with the concomitant elimination of the hematite and ferrosilicon from the cupola charges. It is a mattter of substituting for heat chemically produced in the converter by the silicon combustion, heat physically imparted to the iron prior to the conversion process. To achieve this end a furnace had to be introduced between the cupola and converter in which the iron could be brought up to the temperature at which the carbon reaction starts. If large enough such a furnace would also act as a mixer and reservoir for hot metal, which would make it possible to operate the cupola independently of fluctuations in the demand for steel and to secure greater uniformity in the iron and efficiency in the converter operation.

In designing the cupolas care was taken to provide them with deep wells in order to favor carbon pickup, as the charges were to be composed of steel scrap only. The metal produced by the cupolas has approximately the following composition: 2.7 to 3.2 C; 0.05 to 0.2 Si; 0.3 to 0.7 Mn; 0.11 to 0.18 S, and 0.03 to 0.07 P. After it has been desulphurized, the iron is transferred to the mixer, the temperature being 2336 to 2516 deg. F.

The rotary mixers have a nominal capacity of 12 tons, but may reach 25 tons, depending on the degree of wear of the linings. They are fired by anthracite and the calorific input is such that the iron can be raised to the required temperature at the rate of 17 to 18 tons per hr. The fuel consumption is 80 lb. per ton of metal. After it has been superheated the iron is transferred to the converters in batches of 5600 to 7000 lb. The mixer is continually being refilled by desulphurized cupola metal, usually in lots of 5 tons.

The silicon content in the metal charged into the converter approximates to 0.05 to 0.2 per cent. Iron containing as little as 0.05 per cent silicon has been blown successfully and yielded steel sufficiently hot for foundry requirements.

The advantages of the process may be summarized as follows:

(1) Elimination of hematite and ferrosilicon from the cupola charges.

(2) Reduced consumption of ferrosilicon in the converter.

(3) Appreciable reduction of blowing loss in the converter.

(4) Increased flexibility and production through reduction in blowing and slagging time.

(5) Longer life of converter linings.

(6) Less variation on phosphorus content and in final steel analysis.

(7) More continuity in cupola operation.

(8) Reduced quantity of converter slag and easier removal.

The process has the following disadvantages which must not be overlooked:

(1) Considerable increase in capital expenditure due to the cost of the mixers and the provision of a heavy crane to change the mixer bodies.

(2) Heavier structure needed to support this crane and larger area required by the melting plant.

(3) Higher coke ratios needed in the cupola for melting all-steel charges.

(4) Greater wear on cupola refractories.

(5) Extra labor and upkeep entailed by the operation of the mixers.

(6) Fuel and lining costs of the mixers.

In the particular plant under the review, the items of increased cost were more than offset by the savings due to cheaper charges, reduced metallic loss and improved performance of converter refractories.

Physical Properties Of Some NE Steels

. . . Although the primary purpose of the data reported here was to determine whether certain of the NE steels would meet Navy Department specifications, much general information on the physical properties obtainable as a result of various heat treatments, particularly on specimens of large sections, is made available for the first time. Special emphasis has been placed on the variation of properties in forgings of such size that normalizing and tempering is the only practical method of heat treatment. The data originally appeared in somewhat greater detail in the August 1944 Journal of the American Society of Naval Engineers.

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and

RICHARD E. WILEY
Materials Engineer, Bureau of Ships

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FOR many years the Navy has been investigating the properties of steels employed in the machinery of Naval vessels. Due to the service conditions involved, primary interest has been centered in such properties as notch toughness and fatigue resistance, particularly in alternating torsion. Special emphasis has been placed on the variation of properties in forgings of such size that normalizing and tempering is the only practical method of heat treatment.

The National Emergency steels were developed early in the war to conserve critical alloying elements by utilizing such elements available from scrap and making the maximum use of the alloying constituents for developing hardenability. Although these steels have found fairly wide application in comparatively small machinery parts permitting quenching and tempering, it was necessary to investigate them thoroughly before they could be considered for use in such applications as heavy forgings in the Naval service. Accordingly several NE steels are being studied at the U. S. Naval Engineering Experiment Station at Annapolis, Md. Although this investigation has not yet been completed, it is felt that the information obtained thus far may be of value to industry.

The primary purpose of the investigation is to obtain information as to the strength properties of these steels in large sizes, although small diameter bars are included. Large forgings are required for propulsion shafting and rudder stocks which must conform to the physical properties of Classes AN and HG steels of Navy Department Specification 49S2 (see Table I). Ordinarily, the Navy Department purchases steels in accordance with physical properties rather than chemical requirements.

In all, 36 steels representing 10 grades are being investigated. The sizes range from 1 to 14 in. diameter. Similar steels obtained from different sources are being tested in order to determine the effect of manufacturing variables. In view of interest in these steels in large sections and because of the inherent hardenability, normalizing and tempering heat treatments were given preference over quenching and tempering procedures. The forgings were normalized in full section and tempered in as large sections as practicable, except in those few cases in which the manufacturer performed the entire heat treatment on the forging.

The tests include the determination of static tensile and torsional properties, charpy impact value, hardness, and fatigue resistance in rotating flexure and alternating torsion. The hardenability was determined by means of the Jominy end-quench test. Temperature-expansion (dilatometric) curves were obtained for representative steels. In determining these properties the location of specimens with reference to the cross-section of the forgings was considered. In addition, the high temperature characteristics of some of the steels were determined.

The chemical compositions of all steels were determined and checked against the analyses furnished by the manufacturer and against the range of the grades ordered. Results of chemical analysis are given in Table II and are the average of two or more determinations. It is noted that a considerable number of the NE steels analyzed failed to conform to the specified analysis in one or more elements. In instances where chemical analysis indicated a different grade of steel from that ordered the applicable grade designation is shown in parenthesis. Two of the steels were modified intentionally by the manufacturer.

TABLE I

Physical Requirements of Navy Classes AN and HG Steels

Class	Tensile Strength Min.	Proof Stress Min.	Elong. in 2 in.—min.		Red. of Area—min.	
			Long.	Trans.	Long.	Trans.
	P. S. I.	P. S. I.	%	%	%	%
AN	80,000	45,000	25	21	45	30
HG	95,000	65,000	21	18	45	30

TABLE II

Chemical Composition of NE Steels Tested

EES Designation	NE Number	Size In.	Total Length	Source of Chemical Results	C	S	P	Mn	Si	Cr	Ni	Mo	Hardness Rock. C*
VK	8630	1 dia.	34′	Specs.	.27–.33	.04	.04	.70–.95	.20–.35	.40–.60	.40–.60	.15–.25	
				EES 1	.28	.005	.012	.86	.35	.47	.36	.20	25
WD	8630	8 dia.	24″	EES	.30	.013	.02	.83	.35	.48	.40	.20	
VI	8630	1 dia.	34′	EES 1	.28	.007	.01	.88	.26	.64	.42	.24	26
XG	8630	8 dia.	24″	EES	.30	.025	.011	.75	.26	.41	.36	.20	
VX	8739	1 dia.	47¾″	Specs.	.35–.42	.04	.04	.75–1.00	.20–.35	.40–.60	.40–.60	.20–.30	
				EES 1	.36	.01	.018	.83	.30	.50	.42	.22	29
WE	8739	8 dia.	24″	EES	.39	.011	.017	.75	.28	.53	.44	.22	27
XF	8739	8 dia.	24″	EES	.39	.019	.011	.83	.21	.42	.41	.25	31
XO	8739	1 dia.	30′	Mfr. 2	.40	.013	.020	.88	.27	.48	.48	.25	
				EES 1	.40	.01	.012	.89	.31	.49	.46	.24	31
				EES 2	.41	.01	.004	.89	.31	.51	.46	.24	31
XP	8739	1 dia.	30′	Mfr. 2	.47	.023	.018	.117	.26	.48	.53	.23	
				EES 1	.40	.01	.008	.90	.31	.51	.44	.22	31
				EES 2	.40	.011	.012	.90	.31	.52	.46	.25	30
WG	8739	8 dia.	24″	EES	.40	.015	.02	.85	.24	.46	.40	.22	27
XM	8339	1 dia.	30′	Specs.	.35–.42	.04	.04	1.30–1.60	.20–.35			.20–.30	
				Mfr. 2	.42	.019	.034	1.54	.22			.26	
				EES 1	.38	.021	.013	1.40	.31	.16	.12	.30	33
				EES 2	.40	.018	.013	1.45	.24	.29	.15	.25	35
WH	8339	8 dia.	24″	EES	.40	.021	.018	1.22	.22	.17	.19	.23	29
VO	8339	10 x 10	25″	Mfr.	.44	.031	.027	1.59	.30			.25	
				EES	.43	.031	.021	1.50	.29			.26	34
VG	8744	1 dia.	35½′	Specs.	.40–.47	.04	.04	.75–1.00	.20–.35	.40–.60	.40–.60	.20–.30	
				EES 1	.43	.012	.02	.91	.24	.46	.42	.27	29
VF	8744	8 dia.	24″	EES	.46	.01	.018	.81	.40	.44	.49	.24	34
XN	8442	1 dia.	30′	Specs.	.38–.45	.04	.04	1.30–1.60	.20–.35			.30–.40	
				Mfr. 2	.42	.014	.024	1.38	.26			.33	
				EES 1	.42	.02	.011	1.39	.31	.16	.12	.33	30
				EES 2	.42	.017	.011	1.43	.24	.26	.13	.26	
WJ	8442	8 dia.	24″	EES	.46	.026	.022	1.25	.29	.15	.10	.25	31
VE	8442	1¼ dia.	15′ 10″	EES 1	.38	.024	.022	1.22	.27	.01	.04	.32	
				EES 2	.40	.023	.021	1.33	.23	.01	.02	.32	50
				EES 3	.37	.020	.014	1.23	.22	.01	.02	.35	
				EES 4	.37	.021	.017	1.26	.21	.01	.04	.38	
VJ	8749	1 dia.	39¾′	Specs.	.45–.52	.04	.04	.75–1.00	.20–.35	.40–.60	.40–.60	.20–.30	
				Mfr. 2	.48	.027	.018	.76	.26	.53	.48	.23	
				EES 1	.62	.01	.01	.85	.26	.56	.35	.20	34
WY	8749	6⅞ dia.	23″	EES	.44	.022	.016	.84	.26	.48	.45	.23	38
XJ	8749	8 dia.	24″	Mfr.	.48	.019	.023	.96	.25	.49	.51	.23	
				EES	.44	.015	.011	.97	.23	.42	.41	.23	37
WA	8749	1 dia.	39½′	EES 1	.47	.039	.035	.85	.24	.50	.58	.47	50
				EES 2	.40	.049	.02	.90	.22	.50	.60	.46	
				EES 3	.46	.04	.04	.85	.22	.50	.58	.46	
VM	8749 (8949)	8 dia.	25½″	EES	.48	.037	.03	.81	.22	.50	.58	.45	54
WI	8749 (8739)	8 dia.	24″	EES	.40	.012	.021	.97	.24	.43	.47	.27	
XQ	8749	1 dia.	30′	EES 1	.51			.85		.53	.42	.24	32
				EES 2	.50			.76		.50	.43	.20	
				EES 3	.50			.84		.50	.49	.23	

* Hardness measured 1½ in. From end of Jominy Specimen.

TABLE II—Continued

Chemical Composition of NE Steels Tested

EES Designation	NE Number	Size In.	Total Length	Source of Chemical Results	C	S	P	Mn	Si	Cr	Ni	Mo	Hardness Rock. C*
XU	8749	1 dia.	30′	Mfr. 3	.47	.016	.015	.85	.30	.51	.51	.25	
				EES 1	.50	.006	.016	.85	.30	.51	.33	.25	35
				EES 2	.52	.006	.017	.83	.28	.51	.37	.24	
				EES 3	.47	.02	.017	.85	.28	.50	.26	.25	
XD	8949	1 dia.	30′	Specs.	.45–.52	.04	.04	1.00–1.30	.20–.35	.40–.60	.40–.60	.30–.40	
				Mfr. 1	.45	.018	.023	1.10	.23	.54	.50	.36	
				Mfr. 2	.46	.019	.024	.097	.24	.38	.46	.33	
				EES 1	.44	.012	.022	1.10	.25	.54	.46	.33	
				EES 2	.44	.012	.022	.90	.25	.34	.43	.32	
XE	8949	8 dia.	24″	EES	.44	.016	.012	1.00	.21	.34	.41	.30	37
VZ	8949 (Modified)	1 dia.	40′ 8″	EES 1	.45	.022	.03	.84	.20	.56	.54	.34	32
				EES 2	.44	.018	.03	.84	.20	.59	.54	.35	
				EES 3	.38	.023	.02	.86	.20	.58	.54	.34	
VY	8949 (Modified)	8 dia.	23″	EES	.44	.017	.02	.84	.23	.57	.60	.30	34
VN	8949	1 dia.	32′	EES 1	.45	.007	.022	1.00	.22	.46	.35	.32	52
VD	8949	13¾ dia.	24″	Mfr.	.46	.028	.037	1.28	.26	.59	.47	.36	
				EES	.48	.022	.022	1.10	.34	.54	.51	.37	56
XL	9445 HT 46184	8 dia.	36″	Specs.	.43–.48	.04	.04	1.00–1.30	.40–.60	.20–.40	.20–.50	.08–.15	
				EES	.44	.021	.017	1.00	.46	.24	.44	.15	34
XI	9445 (9450)	10 dia.	36″	EES	.55	.02	.013	1.53	.53	.33	.31	.12	53
XK	9450 HT 42129	8 dia.	36″	Specs.	.48–.53	.04	.04	1.20–1.50	.40–.60	.20–.40	.20–.50	.08–.15	
				EES	.53	.032	.020	1.26	.45	.22	.21	.13	52

* Hardness measured 1½ in. From end of Jominy Specimen.

Mechanical Properties

Mechanical properties of the steels are presented in Table III. Tension tests were made of standard 0.505 in. diameter threaded-end specimens. Static torsion tests were made of 0.75 in. diameter specimens. Charpy impact values were obtained from 10 mm. square keyhole notch specimen.

The fatigue tests in flexure were made with the rotating cantilever type of specimen. In this specimen the test length is conically tapered and so designed that the maximum stress is ¾ in. out from the inner fillet, and the stress varies only about 1.5 per cent over a length of 1.5 in. All specimens were finished by a method of alternate longitudinal and transverse polishing. The surface finish by this method is sufficiently smooth to permit examination of the structure at a magnification of 100 diameters. The test length of the specimens was kept covered with a film of mineral oil throughout the test. The endurance machines were operated continuously at 1450 r.p.m. except for the time required to remove and install specimens.

Endurance tests in alternating torsion were also made for some of the steels. For the tests herein reported, the stress was maintained equal positive and negative from the neutral position. All tests were made at 1475 stress reversals per min.

It will be noted that in general forgings 8 in. in diameter made of steels of the lower carbon ranges investigated can be normalized and drawn so as to conform to the requirements of Navy Class AN steels, and those of the higher carbon ranges, of Class HG.

The average endurance ratio (ratio of endurance limit to tensile strength) for the 20 steels tested in rotating flexure is 0.43, and the corresponding ratio for the alternating torsion tests compares favorably with endurance ratios obtained for alloy steels such as 3½ per cent nickel steel, although the average ratio for the rotating flexure tests is somewhat lower. In this respect, the NE steels tested behave more like carbon steels than alloy steels. The maximum endurance ratio was obtained for the 1¼ in. stock, Material VE, in the quenched and tempered conditions. For the normalized and tempered steels the best values for endurance ratio range from 0.44 to 0.47. In general, good endurance ratios were obtained for the 1300 deg. F. temper.

Brinell readings were taken every ½ in. along a center line for the full cross-section. Maximum and minimum hardness values are reported in Table III on the following pages.

End-quench hardenability tests were made on all the steels, but inasmuch as they conform in general to the curves already published for these steels, they are not reproduced. Likewise the results of hardness tests to determine the response to tempering are in close enough agreement with other published results to make their reproduction unnecessary.

[In the second and concluding part of the article, the authors present laboratory test data on the properties of some NE steels at elevated temperatures with a view to appraise their acceptability as high temperature bolt steels.]

TABLE III

Mechanical and Endurance Properties of National Emergency Steels

Navy Designation	NE No.	Heat Treatment: Normalizing: Size of Section	Normalizing: Temp., Deg. F.	Normalizing: Time Held, Hr.	Quenching: Size of Section, In.	Quenching: Temp., Deg. F.	Quenching: Time Held, Hr.	Quenching: Cooled	Tempering: Size of Section In.	Tempering: Temp., Deg. F.	Tempering: Time Held, Hr.	Location and Direction of Test Specimens	Tensile Strength (Lb. Per Sq. In.)	Proof Stress (Lb. Per Sq. In.)	Yield Strength 1% Set (Lb. Per Sq. In.)	Elongation in 2 In. (Per Cent)	Reduction of Area (Per Cent)	Torsional Properties: Ultimate Strength (Lb. Per Sq. In.)	Torsional Properties: Prop Limit (Lb. Per Sq. In.)	Torsional Properties: Modulus X10⁶ (Lb. Per Sq. In.)	Charpy Impact, Ft-Lb.	Brinell Hard.	Endurance Limits: Rotating Cantilever (Lb. Per Sq. In.)	Endurance Limits: Alternating Torsion (Lb. Per Sq. In.)	Endurance Ratios: Endurance Limit (Flexure) T. S.	Endurance Ratios: Endurance Limit Alt. Tor. T. S.
VK	8630	1" dia.	1600	1½					1" dia.	1000	1½	Average	102,000	75,150	75,750	29.2	59.1					200					
										1200		Average	94,050	66,250	66,600	30.0	62.3					183					
										1500		Average	91,250	62,250	62,550	31.2	62.1					173					
					1" dia.	1550	3½	Oil	1" dia.	1000	1½	Average	128,400	106,050	106,650	21.2	59.5					235					
										1200		Average	108,800	92,250	92,800	27.7	65.6					225					
WD	8630	8" dia. x 24" long	1625	8					Quadrant 11" long	1200	4	Longitudinal	1" from C.	88,800	55,000	55,200	31.0	58.8	67,200	28,000	12.0	29.8	181 to 192	40,000	26,000	.45	.29
													2" from C.	90,000	55,000	55,200	32.0	58.8				32.8					
													3½" from C.	88,000	54,300	54,800	31.5	60.1				32.1					
													3½" from C.	88,500	52,000	52,500	31.5	60.6				35.2					
													Average	88,600	54,100	54,400	31.5	59.6				32.5					
										1300	4		1" from C.	84,200	52,700	53,000	33.0	61.1	67,300	22,000	12.0	31.3	170 to 174	36,000	23,000	.43	.28
													2" from C.	84,000	52,600	53,000	31.5	61.6				30.4					
													3½" from C.	82,500	51,400	52,000	33.0	63.7				33.6					
													3½" from C.	81,500	52,100	52,500	32.5	63.5				33.6					
													3½" from C.	83,800	52,000	52,500	33.3	63.9									
													Average	83,200	52,150	52,600	32.6	62.7				32.2					
VI	8630	1" dia.	1600	1½					1" dia.	1000	1½	Average	96,300	75,000	75,750	29.7	63.7					194					
										1200		Average	88,400	67,200	68,000	31.7	65.6					183					
										1500		Average	83,950	59,200	59,750	33.7	64.5					161					
					1" dia.	1550	1½	Oil	1" dia.	1000	1½	Average	127,650	107,850	110,000	21.0	63.3					283					
										1200		Average	105,150	90,750	91,050	27.0	70.8					211					
XG	8630	8" dia. x 24" long	1600	8					Quadrant 11" long	1200	4	Longitudinal	2" from C.	88,800	54,700	55,000	31.0	60.0				27.6	170 to 178	36,000	24,000	.42	.28
													3" from C.	84,500	51,300	51,500	32.5	60.0				33.1					
													3½" from C.	84,300	50,000	50,500	33.0	60.7				33.6					
													Average	85,850	52,000	52,350	32.2	60.2				31.4					
									1" sq. x 4¾"	1200	4	Trans.	1" from outside	84,250	51,200	51,500	30.5	48.1				18.4					

								1" sq. x 4¾"	1200	4	Trans.	outside	84,250	51,200	51,500	30.5	48.1				18.4								
VX	8739	1" dia.	1600	1					1" dia.	1100	1	Longitudinal	Average	115,600	92,000	92,750	24.2	55.9					230						
										1200			Average	105,050	81,500	84,750	27.0	58.5					207						
										1300			Average	98,900	76,000	77,250	28.7	64.9					200						
										1500			Average	98,700	61,500	63,250	29.9	57.9					177						
					1" dia.	1550	1	Oil	1" dia.	1200	1		Average	128,450	117,000	118,500	23.2	61.3					268						
										1300			Average	113,550	103,500	104,500	24.5	63.1					252						
WE	8739	8" dia. x 24" long	1625	8					Quadrant 11" long	1200	4	Longitudinal	2" from C.	85,000	52,000	52,600	32.0	59.4	66,600	26,000	12.0	32.8	174 to 187	36,000	25,000	.41	.28
													3½" from C.	89,500	52,500	53,000	31.5	56.5				32.1						
													3½" from C.	89,500	53,400	54,000	31.0	56.0				32.1						
													Average	83,000	52,650	53,200	31.5	57.3				32.6						
										1300	5		1" from C.	79,200	50,700	51,000	32.0	62.5	63,800	20,000	12.0	33.6	163 to 169	33,000	24,000	.41	.30
													2" from C.	80,200	49,200	49,600	33.5	62.0				34.4						
													3½" from C.	82,500	53,000	53,500	32.8	62.0				33.6						
													3½" from C.	81,800	51,900	52,000	33.5	61.8				31.3						
													3½" from C.	81,700	47,000	49,000	33.0	62.6										
													Average	81,100	50,350	51,000	33.0	62.2				33.2						
XF	8739	8" dia. x 24" long	1600	8					Quadrant 11" long	1200	5	Longitudinal	1" from C.	87,000	51,000	51,500	23.0	59.8	80,000	30,000	11.9		179 to 197	37,000	25,000	.42	.28
													2" from C.	87,500	53,500	54,000	29.5	62.8				29.8						
													3½" from C.	90,800	59,600	60,000	30.0	62.5				29.8						
													Average	88,400	51,700	55,150	29.1	61.7				29.8						
									1" sq.			Trans.	1" from outside	89,500	57,250	57,750	28.5	53.8										
									Quadrant 11" long	1300	4	Longitudinal	1" from C.	89,000	53,000	53,500	28.0	59.6	69,700	28,400	12.0	30.5	177 to * 192	34,000	25,000	.38	.28
													2" from C	88,000	53,000	53,400	30.5	60.6										
													3" from C.	92,200	61,900	62,300	28.5	61.8				32.1						
													Average	89,700	55,950	56,400	29.0	60.6				31.3						
									1" sq.			Trans.	1" from outside	91,500	56,750	57,200	25.7	43.9										
XO	8739	1" dia.	1600	1					1" dia.	1100	1	Longitudinal	Average	123,600	99,250	99,750	22.0	53.9										
										1200			Average	115,500	93,150	93,500	23.5	56.6										
										1300			Average	114,750	90,850	91,350	21.7	55.8										
										1500			Average	97,000	65,100	66,500	30.7	61.7										
					1" dia.	1550	1	Oil	1" dia.	1100	1		Average	154,000	141,800	145,000	18.2	53.2										
										1200			Average	134,200	127,000	128,000	21.2	57.9										
										1300			Average	110,800	101,500	103,000	26.7	62.5										

TABLE III (Continued)

Mechanical and Endurance Properties of National Emergency Steels

Navy Designation	NE No.	HEAT TREATMENT: Normalizing Size of Section	Normalizing Temp., Deg. F.	Normalizing Time Held, Hr.	Quenching Size of Section, In.	Quenching Temp., Deg. F.	Quenching Time Held, Hr.	Quenching Cooled	Tempering Size of Section In.	Tempering Temp., Deg. F.	Tempering Time Held, Hr.	Location and Direction of Test Specimens	Tensile Strength	Proof Stress	Yield Strength 1% Set	Elongation in 2 In.	Reduction of Area	Torsional Properties: Ultimate Strength	Torsional Properties: Prop Limit	Torsional Properties: Modulus X10⁶	Charpy Impact, Ft.-Lb.	Brinell Hard.	Endurance Limits: Rotating Cantilever	Endurance Limits: Alternating Torsion	Endurance Ratios: Endurance Limit (Flexure) T. S.	Endurance Ratios: Endurance Limit Alt. Tor. T. S.
													Lb. Per Sq. In.			Per Cent		Lb. Per Sq. In.					Lb. Per Sq. In.			
XP	8739	1" dia.	1600	1					1" dia.	1160	1	Average	121,850	97,250	97,650	21.5	54.4										
										1230		Average	116,000	96,600	95,350	22.0	55.9										
										1300		Average	103,250	83,500	83,650	27.7	62.1										
										1475		Average	98,600	66,500	66,750	30.7	60.8										
					1" dia.	1550	1	Oil	1" dia.	1100	1	Average	151,300	142,200	143,500	17.7	52.8										
										1200		Average	131,700	126,500	122,500	20.5	58.4										
										1300		Average	111,400	105,500	106,200	25.5	63.3										
WG	8739	8" dia. x 24" long	1625	8					Quadrant 11" long	1000	4	Longitudinal 1" from C.	94,000	57,000	57,200	26.5	56.0	74,600	20,000	11.9	28.3	187 to 197	38,000	25,000	.40	.26
												2" from C.	94,900	57,000	57,500	27.0	51.7				28.3					
												3" from C.	95,500	58,700	59,200	29.5	53.8				29.0					
												3½" from C.	98,700	61,900	62,400	24.0	53.8				29.8					
												Average	95,750	58,650	59,050	26.7	53.8				28.8					
										1200		1" from C.	84,300	51,000	51,500	30.0	58.3	65,100	19,000	11.9	29.0	179 to 187	38,000	26,000	.43	.30
												2" from C.	90,500	57,200	57,800	30.5	59.0				27.6					
												3" from C.	89,200	53,500	54,000	32.0	57.8				30.5					
												Average	88,000	53,900	54,400	30.8	58.3				29.0					
										1500		1" from C.	87,100	49,000	50,000	25.5	36.0	65,300	21,000	11.9	25.4	173 to 183	38,000	23,000	.43	.26
												2" from C.	88,000	53,200	53,800	29.5	51.7				24.7					
												3" from C.	89,500	51,900	52,500	29.5	52.8									
												3½" from C.	88,000	53,100	53,500	30.0	53.5				26.8					
												3½" from C.	89,200	51,500	52,500	29.2	51.7				26.1					
												Average	88,350	51,750	52,450	28.7	49.1				25.7					
XM	8339	1" dia.	1600	1					1" dia.	1100	1	Average	112,850	91,850	92,250	23.0	57.5									
										1200		Average	105,750	85,450	86,000	24.2	56.2									
										1300		Average	100,250	78,950	79,501	26.2	62.3									
										1500		Average	99,450	67,800	68,250	30.7	62.6									
					1" dia.	1550	1	Oil	1" dia.	1100	1	Average	148,750	138,100	138,700	18.0	55.9									
										1200		Average	117,750	107,300	107,900	24.0	63.6									
										1300		Average	113,750	105,750	106,250	24.7	64.2									

											1200		Average	117,750	107,300	107,900	24.0	63.6													
											1300		Average	113,750	105,750	106,250	24.7	64.2													
WH	8339	8" dia. x 24" long	1625	8		Quadrant 11" long	1000	4	Longitudinal	1" from C.	106,000	70,000	72,200	24.5	53.0	76,000	25,000	11.9	26.8	223 to 241	51,000	31,000	.47	.29
										2" from C.	107,500	75,200	75,800	25.0	53.0				29.8										
										3" from C.	111,000	78,500	80,000	23.0	51.4				23.3										
										3" from C.	110,700	79,500	80,000	28.5	50.8														
										Average	108,800	75,800	77,000	25.2	52.0				26.6										
							1200			1" from C.	91,000	63,000	64,000	30.0	61.8	71,100	21,000	11.8	35.2	194 to 204	43,000	26,500	.46	.28
										2" from C.	92,200	66,000	66,200	28.0	61.6				32.8										
										3" from C.	93,500	67,900	68,500	31.0	60.8				34.4										
										3" from C.	93,700	61,300	68,700	30.5	61.2				33.1										
										3" from C.	96,500	68,500	69,000	28.5	60.7														
										Average	93,400	65,350	67,300	29.6	61.2				33.9										
							1300			1" from C.	87,700	54,000	55,000	30.5	59.0	69,300	18,000	12.1	40.0	179 to 191	42,000	24,000	.47	.27
										2" from C.	89,000	59,700	60,300	31.5	60.3				36.0										
										3½" from C.	94,300	61,300	62,200	29.0	58.8				35.2										
										3½" from C.	88,900	63,500	65,000	32.0	63.8				32.7										
										Average	89,950	59,600	60,600	30.7	60.5				35.9										
							1500			1" from C.	92,500	57,000	57,500	29.5	52.5	70,800	19,000	12.0	27.6	187 to 202	41,000	25,000	.43	.26
										2" from C.	94,500	59,100	60,000	30.0	53.2				27.6										
										3½" from C.	99,000	63,100	63,500	27.5	53.6				25.4										
										3½" from C.	99,800	59,000	59,700	27.5	54.0				23.3										
										Average	96,450	59,550	60,100	28.6	53.3				26.1										
VO	8339	10" Sq. x 25" long	NORMALIZED AND TEMPERED BY MANUFACTURER						Longitudinal	Position 2	120,500	54,000	75,000	6.0*	4.3					255 to 269	45,000		.38	
										Position 2	119,500	55,000	75,000	5.0*	4.3														
										Position 9	119,800	66,700	76,000	13.7	15.6														
										Position 9	119,200	66,700	77,500	7.8	9.6														
										Position 13	120,000	56,200	76,200	20.0	41.0				12.5										
										Position 16	120,000	58,000	76,000	17.5	35.3														
										Position 16	120,500	56,000	76,000	18.0	36.3														
										Average	119,900	58,950	75,950	12.6	20.9				12.5										
									Transverse	1" fr. surface	120,000	56,500	75,000	12.0	11.8				9.3										
										4" fr. surface	111,000	51,200	72,500	5.0	5.4				8.7										
										4" fr. surface	114,000	51,900	76,500	4.5	3.9				4.6										
										4" fr. surface	112,000	53,000	76,000	4.0	4.3				3.8										
										45° to surface	121,500	56,200	76,700	8.5	9.6				8.2										
										45° to surface	122,200	53,700	76,200	8.5	11.5				8.9										
										Average	116,800	53,750	75,500	7.1	7.8				7.3										

* Broke outside punch marks

TABLE III (Continued)

Mechanical and Endurance Properties of National Emergency Steels

Navy Designation	NE No.	HEAT TREATMENT: Normalizing Size of Section	Normalizing Temp., Deg. F.	Normalizing Time Held, Hr.	Quenching Size of Section, In.	Quenching Temp., Deg. F.	Quenching Time Held, Hr.	Quenching Cooled	Tempering Size of Section	Tempering Temp., Deg. F.	Tempering Time Held, Hr.	Location and Direction of Test Specimens	MECHANICAL PROPERTIES: Tensile Properties: Tensile Strength (Lb. Per Sq. In.)	Proof Stress (Lb. Per Sq. In.)	Yield Strength 1% Set (Lb. Per Sq. In.)	Elongation in 2 In. (Per Cent)	Reduction of Area (Per Cent)	Torsional Properties: Ultimate Strength (Lb. Per Sq. In.)	Prop Limit (Lb. Per Sq. In.)	Modulus X10⁶ (Lb. Per Sq. In.)	Charpy Impact, Ft.-Lb.	Brinell Hard.	ENDURANCE PROPERTIES: Endurance Limits: Rotating Cantilever (Lb. Per Sq. In.)	Alternating Torsion (Lb. Per Sq. In.)	Endurance Ratios: Endurance Limit (Flexure) T. S.	Endurance Limit Alt. Tor. T. S.
VG	8744	1" dia.	1600	1½					1" dia.	1000	1½	Average	140,850	97,950	102,050	18.7	45.5					292				
										1200		Average	128,450	96,100	98,200	20.0	51.4					262				
										1500		Average	122,500	70,000	70,750	22.2	45.1					244				
					1" dia.	1550	1½	Oil	1" dia.	1000	1½	Average	186,400	165,100	173,250	15.2	42.9					395				
										1200		Average	141,500	129,400	130,250	20.5	55.7					295				
VF	8744	8" dia. x 24" long	1600	4					Quadrant 11" long	1000	3	Longitudinal 1" from C.	117,700	67,500	79,500	21.3	46.6									
												2" from C.	117,000	68,000	70,000	21.0	48.1				15.4					
												3½" from C.	122,000	73,000	77,000	21.5	43.0	83,100	30,000	12.2	19.2	207 to 217	46,000	33,000	.39	.28
												3½" from C.	117,000	70,500	77,000	21.2	46.9									
												Average	118,400	69,750	75,900	21.2	46.1				17.3					
										1100		1" from C.	119,700	66,000	72,000	20.6	42.8				16.7					
												2" from C.	119,900	68,500	72,000	23.0	44.6				19.9					
												3½" from C.	119,000	71,000	73,500	21.5	45.4	81,600	32,000	12.0		212 to 223	47,000	32,000	.39	.27
												3½" from C.	120,300	74,000	76,500	21.3	44.5									
												Average	119,700	69,900	73,500	21.6	44.3				18.3					
										1275		1" from C.	105,000	61,000	62,500	24.5	45.5				20.6					
												2" from C.	105,900	63,500	65,000	26.2	53.6				21.9					
												3½" from C.	107,300	69,000	70,900	25.5	54.3	79,100	35,500	12.0	24.7	205 to 207	43,000	31,500	.41	.30
												3½" from C.	103,500	69,000	70,000	25.0	56.1				23.3					
												Average	105,400	65,600	66,900	25.3	52.4				22.6					
										1500		1" from C.	105,500	55,500	56,500	23.0	43.0				16.4					
												2" from C.	101,900	57,000	57,500	25.8	46.8				16.7					
												3½" from C.	100,200	57,000	58,000	27.5	48.1	72,400	28,000	12.1	19.0	174 to 179	41,000	27,000	.40	.27
												3½" from C.	99,400	53,500	55,500	28.0	47.5				19.9					
												Average	101,750	55,750	56,900	26.0	46.3				18.0					

XN	8442	1" dia.	1600	1					1" dia.	1000	1	Average	116,000	91,750	92,250	23.0	58.5										
										1200		Average	110,900	88,500	89,000	24.2	61.9										
										1300		Average	103,000	81,100	81,400	26.7	63.4										
										1500		Average	102,000	70,950	71,100	29.2	59.0										
					1" dia.	1550	1	Oil	1" dia.	1100	1	Average	155,500	145,900	146,650	18.7	58.0										
										1200		Average	125,250	120,000	120,750	24.5	63.5										
										1300			109,900	103,350	104,000	26.5	66.3										
WJ	8442	8" dia. x 24" long	1625	8					Quadrant 11" long	1000	4	Longitudinal	1" from C.	106,000	76,500	77,500	25.0	54.1	80,100	20,000	11.9	29.0	223 to 241	48,000	33,000	.44	.30
													1½" from C.	107,400	75,000	77,400	24.0	51.9				24.7					
													3" from C.	112,500	80,600	82,800	20.5	51.7				21.9					
													3½" from C.	113,000	83,100	83,600	22.0	51.9				21.2					
													Average	109,700	78,800	80,300	22.9	52.4				24.2					
										1200			1" from C.	91,300	64,000	64,400	29.5	60.1	73,100	20,000	11.9	32.1	197 to 210	43,000	28,000	.45	.29
													3" from C.	96,500	71,200	71,800	27.5	59.8				32.8					
													3" from C.	97,200	69,000	70,000	28.0	58.6				29.9					
													3½" from C.	96,500	68,500	69,000	29.5	60.3				32.1					
													Average	95,350	68,150	68,800	28.6	59.7				31.7					
										1300			1" from C.	90,000	57,000	57,300	30.0	60.3	71,800	21,000	12.0	32.1	185 to 197	41,000		.45	
													2" from C.	92,500	58,700	59,000	29.0	59.4				34.4					
													3¼" from C.	89,000	61,900	62,500	30.0	61.7									
													3¼" from C.	94,000	59,500	61,500	30.0	59.3				27.6					
													3½" from C.	88,500	58,700	59,200	32.0	62.0				28.6					
													Average	90,800	59,150	59,900	30.2	60.5				30.6					
										1500			1" from C.	93,000	58,200	58,600	29.0	54.1	71,300	28,000	12.2	24.4	195 to 207	41,000	27,000	.44	.28
													2" from C.	96,500	60,000	60,500	29.0	50.8				26.1					
													3¼" from C.	97,500	59,000	60,000	27.5	52.7									
													3½" from C.	98,000	62,100	62,500	30.0	53.0				23.6					
													Average	96,250	59,800	60,400	28.8	52.6				24.7					
VE	8442	1¼" dia.	1600	1					1¼"	1500	1	Average	108,850	72,250	75,750	26.2	54.8					216				
					1¼" dia.	1550	1	Oil	1¼"	1000	1	Average	139,250	107,500	109,500	17.8	55.2					316	76,000		.54	
										1200		Average	116,350	93,000	94,500	23.5	65.4				52.8	242	53,000	36,000	.50	.31
VJ	8749	1" dia.	1600	1½					1" dia.	1000	1½	Average	125,600	93,750	94,550	21.5	53.0					258				
										1200		Average	112,750	83,900	84,450	24.2	57.1					229				
										1500		Average	108,700	64,900	65,200	26.5	54.0					207				
					1" dia.	1550	1½	Oil	1" dia.	1000	1½	Average	171,000	153,750	158,200	18.0	56.1					346				
										1200		Average	130,650	119,250	120,000	24.0	63.0					282				

TABLE III (Continued)

Mechanical and Endurance Properties of National Emergency Steels

Navy Designation	NE No.	HEAT TREATMENT: Normalizing Size of Section	Normalizing Temp., Deg. F.	Normalizing Time Held, Hr.	Quenching Size of Section, In.	Quenching Temp., Deg. F.	Quenching Time Held, Hr.	Quenching Cooled	Tempering Size of Section In.	Tempering Temp., Deg. F.	Tempering Time Held, Hr.	Location and Direction of Test Specimens		Tensile Strength	Proof Stress	Yield Strength 1% Set	Elongation in 2 In.	Reduction of Area	Torsional Ultimate Strength	Torsional Prop Limit	Torsional Modulus X10⁶	Charpy Impact, Ft-Lb.	Brinell Hard.	Endurance Limits: Rotating Cantilever	Endurance Limits: Alternating Torsion	Endurance Ratios: Endurance Limit (Flexure) / T. S.	Endurance Ratios: Endurance Limit Alt. Tor. / T. S.
														Lb. Per Sq. In.			Per Cent		Lb. Per Sq. In.					Lb. Per Sq. In.			
WY	8749	6⅞" dia. x 23" long	1600	7					Quadrant 11" long	1200	4	Longitudinal	½" from C.	107,500	69,400	70,000	26.0	55.9	78,300	42,000	11.9	27.6	217 to 229	49,000	34,000	.45	.31
													1½" from C.	108,700	72,500	73,500	25.0	56.2				27.6					
													Average	108,100	70,950	71,750	25.5	56.0				27.6					
									1" sq.			Trans.	1½" from outside	107,700	73,500	74,000	19.0	29.1									
									Quadrant 11" long	1300		Longitudinal	1½" from C.	98,000	70,200	70,700	30.5	61.1	73,100	30,000	12.0	30.7	207 to 213	44,000	31,000	.44	.31
													2½" from C.	99,000	66,200	66,800	30.0	61.1				29.0					
													2½" from C.	100,200	70,200	70,700	28.0	61.1				29.6					
													Average	99,100	68,800	69,400	29.5	61.1				29.7					
									1" sq.			Trans.	2½" from outside	98,200	62,000	64,200	20.0	29.8									
XJ	8749	8" dia. x 24" long	1600	8					Quadrant 11" long	1200	4	Longitudinal	1" from C.	104,000	69,500	70,000	25.5	54.4	75,200	38,000	12.0	23.4	212 to 218	47,000	31,000	.46	.31
													2" from C.	102,700	70,400	71,000	25.0	58.6				28.3					
													3" from C.	100,000	67,500	68,000	28.0	59.6				29.2					
													3½" from C.	100,000	67,500	68,000	27.5	60.2				26.8					
													Average	101,650	68,700	69,250	26.5	53.2				26.9					
									1" sq.			Trans.	1" from outside	101,250	68,700	69,250	23.6	43.5				15.3					
									Quadrant 11" long	1300		Longitudinal	1" from C.	99,000	66,500	67,000	26.0	58.6	75,600	38,000	12.0	24.1	217 to 229	46,000	30,000	.45	.30
													2" from C.	106,500	70,000	70,500	24.0	54.7				26.3					
													3" from C.	100,500	69,000	69,400	27.0	60.0				27.3					
													3½" from C.	99,000	66,500	66,900	32.0	60.0				29.8					
													Average	101,250	68,000	68,450	27.2	58.3				26.9					
									1" sq.			Trans.	1" from outside	107,750	70,600	71,050	19.2	42.5				17.1					
WA	8749	1" dia.	1600	1					1" dia.	1100	1		Average	176,350	135,450	145,000	17.2	47.4									
										1200			Average	151,500	118,350	122,850	18.5	55.3									
										1250			Average	133,800	99,500	102,750	20.7	57.1									
										1325			Average	121,050	78,250	82,500	24.1	58.2									
										1400			Average	153,300	80,900	104,000	17.2	46.9									
										1000			½" from C.	148,600	78,000	101,000	14.0	30.9	100,100	41,000	11.9	4.7	302 to 311	53,000	40,000	.35	.27
													2" from C.	151,100	78,000	104,000	16.0	34.6				4.6					
													3¼" from C.	149,200	86,000	106,000	15.8	37.4				4.8					
													3½" from C.	150,700	87,500	108,000	16.7	38.8				6.3					

									½" from C.	148,600	78,000	101,000	14.0	30.9				4.7				
									2" from C.	151,100	78,000	104,000	16.0	34.8				4.6				
								1000	3¼" from C.	149,200	86,000	106,000	15.8	37.4	100,100	41,000	11.9	4.8	302 to 311	53,000	40,000	.35	.27
									3½" from C.	150,700	87,500	108,000	16.7	38.8				6.3				
									Average	149,900	82,350	104,750	15.6	35.5				5.1				
									½" from C.	127,100	81,000	90,000	16.4	43.3				14.3				
									2" from C.	122,000	78,000	86,000	19.3	45.8								
								1200	3½" from C.	122,500	80,000	85,500	20.5	47.4	86,800	46,500	12.0	13.6	255 to 269	52,000	33,000	.42	.26
									3½" from C.	128,500	85,000	94,000	18.0	60.6				17.3				
VM	8749	8" dia. x 25" long	1625	8		Quadrant 11" long	3	Longitudinal	Average	125,000	81,000	88,850	18.5	49.3				15.0				
									½" from C.	106,100	60,500	65,700	22.0	50.5				20.6				
									2" from C.	110,300	51,500	61,500	22.6	48.6				21.2				
								1300	3¼" from C.	110,400	59,000	66,500	22.0	53.7	79,900	41,000	12.2	20.3	241 to 248	51,000	31,000	.46	.28
									3½" from C.	113,400	74,500	77,000	22.3	52.7				23.4				
									Average	110,050	61,350	67,650	22.2	51.4				21.3				
									2" from C.	146,700	66,000	94,000	14.5	32.5				9.2				
									3¼" from C.	150,000	57,500	92,500	14.5	31.4				11.4				
								1500	3½" from C.	149,000	58,000	92,000	14.0	32.8	97,800	29,000	11.8	10.2	293 to 311	52,000		.35	
									3¼" from C.	150,000	63,000	93,000	14.0	32.5				11.2				
									Average	148,900	61,100	92,900	14.2	32.3				10.5				
									¾" from C.	126,000	81,500	87,500	20.5	45.0				16.1				
									2" from C.	125,500	84,000	87,500	20.0	43.4								
								1000	3" from C.	125,000	85,000	88,500	21.0	46.6	86,300	19,000	11.7	13.0	269 to 277	55,000	37,000	.45	.31
									3¼" from C.	107,500	61,000	61,500	21.5	33.1				15.4				
									Average	121,000	77,850	81,250	20.7	42.0				14.8				
									¾" from C.	104,700	71,000	71,500	28.0	55.5				22.6				
									1¾" from C.	106,200	71,000	71,500	24.0	53.8				23.3				
								1200	3" from C.	107,000	71,200	71,600	24.5	53.0	75,600	19,000	12.0	20.6	223 to 229	49,000	33,000	.46	.31
									3" from C.	105,200	69,000	70,000	26.5	55.7								
									3½" from C.	106,500	71,600	72,000	25.5	54.8								
									Average	105,900	70,750	71,300	25.7	54.6				22.2				
									¾" from C.	94,000	58,700	59,200	30.0	61.8				25.8				
									2¼" from C.	96,500	61,500	65,000	27.5	59.8				29.8				
								1300	3½" from C.	96,500	62,500	63,000	26.5	60.0	72,300	19,000	11.8	26.1	197 to 204	42,000	29,000	.44	.30
									3½" from C.	93,700	58,500	60,000	29.0	61.6				29.2				
WI	8749	8" dia. x 24" long	1625	8		Quadrant 11" long	4	Longitudinal	3½" from C.	96,800	62,000	62,500	29.0	60.6								
									Average	95,500	60,650	61,950	28.4	60.8				27.7				
									¾" from C.	111,500	50,500	55,000	21.8	38.8				13.6				
									2¼" from C.	120,500	56,200	56,500	24.0	41.7				15.4				
								1500	3½" from C.	109,500	56,000	57,500	23.0	42.1	80,600	17,700	12.1	16.1	224 to 231	46,000		.40	
									3½" from C.	120,500	56,900	57,000	25.0	44.0				22.7				
									3½" from C.	110,200	55,400	56,000	24.5	42.1								
									Average	114,450	55,000	56,400	23.7	41.7				16.9				

TABLE III (Continued)

Mechanical and Endurance Properties of National Emergency Steels

Navy Designation	NE No.	HEAT TREATMENT: Normalizing Size of Section	Normalizing Temp., Deg. F.	Normalizing Time Held, Hr.	Quenching Size of Section, In.	Quenching Temp., Deg. F.	Quenching Time Held, Hr.	Quenching Cooled	Tempering Size of Section In.	Tempering Temp., Deg. F.	Tempering Time Held, Hr.	Location and Direction of Test Specimens	MECHANICAL PROPERTIES: Tensile Properties: Tensile Strength (Lb. Per Sq. In.)	Proof Stress (Lb. Per Sq. In.)	Yield Strength 1% Set (Lb. Per Sq. In.)	Elongation in 2 In. (Per Cent)	Reduction of Area (Per Cent)	Torsional Properties: Ultimate Strength (Lb. Per Sq. In.)	Prop Limit (Lb. Per Sq. In.)	Modulus X10⁶ (Lb. Per Sq. In.)	Charpy Impact, Ft.-Lb.	Brinell Hard.	ENDURANCE PROPERTIES: Endurance Limits: Rotating Cantilever (Lb. Per Sq. In.)	Alternating Torsion (Lb. Per Sq. In.)	Endurance Ratios: Endurance Limit (Flexure) T. S.	Endurance Limit Alt. Tor. T. S.
XQ	8749	1" dia.	1600	1					1" dia.	1000	1	Average	126,900	91,050	92,600	19.1	47.5									
										1200		Average	111,950	81,650	82,000	23.0	52.9									
										1300		Average	102,750	76,250	76,750	22.7	55.9									
										1475		Average	103,750	62,800	63,250	28.0	54.0									
					1" dia.	1550	1	Oil	1" dia.	1000	1	Average	180,500	165,000	169,200	14.5	45.1									
										1200		Average	138,200	125,500	125,900	20.8	55.9									
										1300		Average	119,000	111,250	111,850	25.0	59.2									
XU	8749	1" dia.	1600	1					1" dia.	1100	1	Average	128,350	101,250	101,650	22.2	52.1									
										1200		Average	120,000	93,200	93,600	21.7	54.3									
										1300		Average	112,000	86,100	86,400	23.7	57.2									
										1475		Average	107,100	66,850	67,250	27.0	57.0									
					1" dia.	1550	1	Oil	1" dia.	1100	1	Average	168,550	160,400	160,900	15.8	48.8									
										1200		Average	138,750	132,350	133,100	18.7	55.3									
										1300		Average	118,900	115,850	116,400	23.5	59.4									
XD	8949	1" dia.	1600	1					1" dia.	1000	1	Average	136,800	102,350	105,000	19.7	56.5									
										1100		Average	127,100	96,400	97,300	21.7	58.7									
										1200		Average	119,000	89,200	89,500	22.5	58.5									
										1350		Average	106,750	77,850	78,200	26.7	65.8									
										1000		Average	186,000	167,300	172,300	16.2	54.1									
										1100		Average	154,250	146,200	146,750	20.2	58.5									
					1" dia.	1550	1	Oil	1" dia.	1200	1	Average	143,250	132,400	132,750	20.2	59.9									
										1350		Average	107,500	98,250	99,050	30.2	68.0									
									Quadrant 11" long	1200	5	Longitudinal	2" from C.	97,000	62,500	63,000	27.5	57.2	72,000	34,400	12.0	27.6	201 to 212	42,000	27,500	.43	.28
													3" from C.	97,500	61,200	61,800	29.5	57.7				24.0					
													3½" from C.	96,900	59,000	62,500	27.6	57.5				26.8					
													Average	97,100	60,900	62,400	28.1	57.5									

XE	8949	8" dia. x 24" long	1600	8		Quadrant 11" long	1200	5	Longitudinal	2" from C.	97,000	62,500	63,000	27.5	57.2	72,000	34,400	12.0	27.6	201 to 212	42,000	27,500	.43	.28
										3" from C.	97,500	61,200	61,800	29.5	57.7				24.0						
										3½" from C.	96,900	59,000	62,500	27.6	57.5				26.8						
										Average	97,100	60,900	62,400	28.1	57.5				26.1						
						1" sq. x 4¾"			Trans.	1" from outside	95,500	62,500	62,950	25.2	39.5				15.0						
						Quadrant 11" long	1300	4	Longitudinal	1" from C.	94,000	59,700	60,400	29.5	58.8	74,900	33,000	12.0	28.7	197 to 203	43,500	30,000	.46	.32
										2" from C.	96,000	59,500	60,000	30.0	60.2				13.0						
										3" from C.	94,000	58,700	59,400	29.5	58.6				25.0						
										3¼" from C.	95,500	61,200	62,500	29.5	59.3				27.6						
										Average	94,900	59,800	60,600	29.6	59.2				23.5						
						1" sq. x 4¾"			Trans.	1" from outside	100,250	64,100	64,650	22.5	37.8				17.9						
VZ	8949	1" dia.	1600	1		1" dia.	1100	1		Average	131,250	87,750	96,000	20.0	51.5										
							1200			Average	123,350	89,750	91,750	20.5	54.8										
							1300			Average	110,000	80,000	82,250	23.0	59.8										
							1450			Average	101,400	61,500	62,250	23.7	57.3										
					1" dia. 1550 1 Oil	1" dia.	1200	1		Average	145,250	129,750	130,750	20.5	58.6										
VY	8949	8" dia. x 23" long	1625	8		Quadrant 11" long	1200	4	Longitudinal	2" from C.	102,400	71,000	72,500	22.5	48.1	73,600	27,000	11.8	25.6	221 to 232	51,000	33,000	.49	.32
										2½" from C.	104,000	72,500	76,200	23.0	51.1										
										3" from C.	106,500	78,100	78,700	24.0	51.4				22.6						
										3¼" from C.	105,500	78,800	79,400	24.5	50.8				21.8						
										Average*	104,600	75,100	76,700	23.5	50.3				23.3						
							1300	4		½" from C.	90,600	61,000	62,500	26.5	54.7	72,300	25,000	11.7	33.6	197 to 203	47,000	29,000	.50	.31
										2" from C.	93,200	65,600	66,000	28.5	60.1				27.7						
										3¼" from C.	96,000	67,500	68,000	27.5	59.3				29.0						
										3¼" from C.	94,000	66,000	66,200	28.5	60.0				27.9						
										Average	93,450	65,000	65,700	27.7	58.5				29.5						
							1475			½" from C.	95,200	56,000	57,500	27.5	51.4	72,400	20,000	11.9	20.6	198 to 215	44,000	29,000	.44	.29
										2" from C.	97,000	57,500	58,000	23.5	41.5				19.9						
										3¼" from C.	103,500	61,500	62,300	26.0	43.4				24.0						
										3½" from C.	102,000	62,500	63,100	26.0	44.9				19.9						
										3½" from C.	102,600	59,000	60,000	24.5	44.9										
										Average	100,050	59,300	60,200	25.5	45.2				20.1						
VN	8949	1" dia.	1600	1		1" dia.	1100	1		Average	137,300	98,500	102,000	20.9	53.9					302					
							1200			Average	120,600	88,500	90,500	22.4	57.6					225					
							1300			Average	108,200	79,500	80,100	25.5	61.7					207					
							1450			Average	115,400	74,000	75,100	25.4	56.3										
					1" dia. 1550 1 Oil	1" dia.	1200	1		Average	139,400	131,000	131,500	20.3	56.3										

TABLE III (Continued)

Mechanical and Endurance Properties of National Emergency Steels

Navy Designation	NE No.	Heat Treatment: Normalizing Size of Section	Normalizing Temp., Deg. F.	Normalizing Time Held, Hr.	Quenching Size of Section, In.	Quenching Temp., Deg. F.	Quenching Time Held, Hr.	Quenching Cooled	Tempering Size of Section In.	Tempering Temp., Deg. F.	Tempering Time Held, Hr.	Location and Direction of Test Specimens		Tensile Strength	Proof Stress	Yield Strength 1% Set	Elongation in 2 In.	Reduction of Area	Ultimate Strength	Prop Limit	Modulus X10⁶	Charpy Impact, Ft.-Lb.	Brinell Hard.	Endurance Limits: Rotating Cantilever	Endurance Limits: Alternating Torsion	Endurance Ratios: Endurance Limit (Flexure) T. S.	Endurance Ratios: Endurance Limit Alt. Tor. T. S.
														Lb. Per Sq. In.			Per Cent		Lb. Per Sq. In.					Lb. Per Sq. In.			
		As Received 13¾" dia.										Longitudinal	3" from C.	106,700	43,000	46,200	19.0	24.8					217 to 223	42,000	27,000	.39	.25
													3" from C.	106,600	42,000	46,000	18.0	24.1									
													Average	106,650	42,500	46,100	18.5	24.4									
		As Received 13¾" dia.							Quadrant 11" long	1100	5	Longitudinal	3¼" from C.	105,600		45,000	19.0	23.4	76,800	21,600	12.2		212 to 216	42,000	27,000	.41	.26
													3¼" from C.	104,100	42,500	45,200	18.5	24.4	77,000	21,600	12.4						
													6" from C.	102,100	43,800	46,500	20.0	28.9									
													6" from C.	102,900	38,800	46,500	18.5	24.5									
													Average	103,650	41,700	45,800	19.0	25.3	76,900	21,600	12.3						
												Trans.	3½" from C.	101,750	42,150	44,100	9.8	8.1									
VD	8949									1200	3	Longitudinal	3¼" from C.	105,400	42,800	46,000	20.0	23.1					217 to 224	38,000	27,500	.37	.27
													3¼" from C.	105,100	42,500	45,500	18.5	25.2									
													6" from C.	102,300	42,800	46,400	20.0	27.2									
													6" from C.	101,900	43,000	46,400	19.5	26.5									
													Average	103,700	42,750	46,050	19.5	25.5									
												Trans.	3½" from C.	102,400	42,750	46,350	10.3	10.1									
		1" sq.	1600	6					1" sq.	1300	2	Long.	Average	130,600	102,500	104,500	19.2	55.4									
		Quadrant 11" long	1600	6						1300	6	Long.	Average	106,300	69,750	73,250	24.8	59.9	78,750	38,350	12.1		223 to 230	50,000	31,000	.47	.29
												Rad.	Average	105,700	71,650	74,150	14.7	20.1									
					13¾" x 11" long	1600	6	Oil	Quadrant 11" long	1100	12	Longitudinal	1" from C.	173,000	123,100	143,600	11.0	20.9					341 to 384	66,000		.39	
													1" from C.	174,800	120,700	147,600	15.0	38.0									
													3¼" from C.	168,100	124,800	138,000	16.0	40.6	108,900	70,000	12.0						
													3¼" from C.	168,000	123,000	138,200	16.0	44.5									
													6" from C.	170,500	130,500	145,400	14.5	41.2	109,400	70,000	12.0						
													6" from C.	169,400	133,700	140,200	17.0	43.5	110,000	69,000	12.0						
													Average	170,650	125,950	142,150	14.9	38.1	109,450	69,650	12.0						
												Rad.	2" from C.	161,900	127,050	136,750	5.0	8.8									
													1" from C.	125,300	98,800	103,400	8.0	14.4									
													1" from C.	134,700	102,500	108,100	14.0	27.5									
													3¼" from C.	130,800	100,300	102,500	20.0	52.7	85,900	54,000	12.0						

										Rad.	2" from C.	161,900	127,050	136,750	5.0	8.8											
VD (cont.)	8949			13¾" x 11" long	1600	6	Oil	Quadrant 11" long	1200	4	Longitudinal	1" from C.	125,300	98,800	103,400	6.0	14.4					262 to 285	55,000	39,000	.42	.30
												1" from C.	134,700	102,500	108,100	14.0	27.5									
												3¼" from C.	130,800	100,300	102,500	20.0	52.7	85,900	54,000	12.0						
												3¼" from C.	133,000	101,200	105,000	17.0	48.9									
												6" from C.	127,800	100,300	101,800	21.0	55.5	89,900	54,000	12.1						
												6" from C.	130,700	102,100	104,000	19.0	56.0	89,000	58,000	12.0						
												Average	130,400	100,850	104,150	16.1	42.5	88,250	55,350	12.0						
											Rad.	2" from C.	130,650	101,850	104,050	8.5	10.9									
									1260	4	Longitudinal	1" from C.	122,300	89,500	93,500	22.0	56.2					252 to 257	53,000	34,000	.44	.28
												1" from C.	125,300	93,200	94,700	20.0	53.5									
												3¼" from C.	118,800	87,000	94,500	23.0	55.9	80,700	50,000	12.0						
												3¼" from C.	122,000	90,000	92,500	19.0	56.0									
												6" from C.	119,300	91,100	92,900	21.0	57.3	79,700	52,000	11.9						
												6" from C.	121,800	94,500	94,700	22.0	56.2	79,100	52,000	12.0						
												Average	121,600	90,900	93,800	21.1	55.8	79,850	51,300	12.0						
											Rad.	2" from C.	120,100	89,050	92,400	11.7	21.2									
									1300	4	Longitudinal	1" from C.	116,500	86,500	89,000	25.0	57.3					229 to 235	50,000	34,000	.44	.30
												1" from C.	114,500	83,700	86,200	23.0	47.8									
												3¼" from C.	110,900	78,300	88,500	25.5	58.8	76,700	44,000	12.0						
												3¼" from C.	113,300	80,200	81,400	22.0	58.2									
												6" from C.	110,900	76,300	80,500	23.0	58.8	79,700	43,200	12.0						
												6" from C.	112,900	84,200	85,200	23.0	59.5	82,000	45,000	12.0						
												Average	113,150	81,500	85,100	23.6	56.7	79,450	44,050	12.0						
											Rad.	2" from C.	111,600	78,800	82,150	14.8	20.3									
XL	9445	8" dia. x 36" long	1650	8				Quadrant 11" long	1200	4	Longitudinal	1" from C.	113,000	64,200	65,000	22.0	47.8	73,600	28,000	12.1	23.4	207 to 212	45,000	31,000	.42	.29
												2" from C.	103,700	57,200	57,700	25.5	54.3									
												3" from C.	106,700	62,500	63,000	24.0	55.5				24.7					
												3½" from C.	102,000	59,400	60,000	29.5	57.3				24.0					
												Average	106,350	60,800	61,400	25.2	53.7				14.2					
								1" sq. x 4¾"			Trans.	1" fr. outside	125,500	84,900	89,000	21.0	46.6				15.4					
												2" fr. outside	111,000	62,200	62,500	17.0	28.8				14.8					
												Average	118,250	73,550	75,750	19.0	37.7				21.9					
								Quadrant 11" long	1300		Longitudinal	1" from C.	101,500	56,000	58,500	27.0	54.5	71,100	26,400	12.0	24.7	197 to 217	43,000		.43	
												2" from C.	100,000	55,500	57,500	27.0	53.3				25.7					
												3" from C.	98,000	59,000	60,000	30.0	58.8				26.1					
												3½" from C.	99,500	61,000	61,300	29.0	58.8				24.3					
												Average	99,750	57,850	59,300	28.2	56.3				14.9					
								1" sq.			Trans.	1" from outside	99,250	58,250	56,550	22.7	36.6									

TABLE III (Continued)

Mechanical and Endurance Properties of National Emergency Steels

Navy Designation	NE No.	HEAT TREATMENT: Normalizing Size of Section	Normalizing Temp., Deg. F.	Normalizing Time Held, Hr.	Quenching Size of Section, In.	Quenching Temp., Deg. F.	Quenching Time Held, Hr.	Quenching Cooled	Tempering Size of Section In.	Tempering Temp., Deg. F.	Tempering Time Held, Hr.	Location and Direction of Test Specimens		Tensile Strength (Lb. Per Sq. In.)	Proof Stress (Lb. Per Sq. In.)	Yield Strength 1% Set (Lb. Per Sq. In.)	Elongation in 2 In. (Per Cent)	Reduction of Area (Per Cent)	Torsional Properties: Ultimate Strength (Lb. Per Sq. In.)	Torsional Properties: Prop Limit (Lb. Per Sq. In.)	Torsional Properties: Modulus X10⁶ (Lb. Per Sq. In.)	Charpy Impact, Ft.-Lb.	Brinell Hard.	Endurance Limits: Rotating Cantilever (Lb. Per Sq. In.)	Endurance Limits: Alternating Torsion (Lb. Per Sq. In.)	Endurance Ratios: Endurance Limit (Flexure) T. S.	Endurance Ratios: Endurance Limit Alt. Tor. T. S.
XI	9445	10" dia. x 36" long	1050	10					Quadrant 11" long	1200	5	Longitudinal	1" from C.	116,500	54,000	58,700	18.5	27.5	63,400	26,000	12.0	10.7	235 to 241	47,000	32,000	.40	.28
													2" from C.	117,500	56,200	58,500	22.0	40.4				15.6					
													3" from C.	116,500	54,400	56,300	22.0	39.4				14.2					
													3½" from C.	115,500	57,500	58,100	24.0	43.1				14.2					
													4½" from C.	116,500	59,200	60,000	22.0	46.5				16.7					
													Average	116,500	56,250	58,300	21.7	39.4				14.3					
									1" sq.			Trans.	1" fr. outside	115,000	57,500	57,700	20.0	32.1				11.9					
													2" fr. outside	114,000	53,100	54,100	17.5	23.7				12.8					
													Average	114,500	55,300	55,900	18.7	27.9				12.3					
XK	9450	8" dia. x 36" long	1650	8					Quadrant 11" long	1200	4	Longitudinal	1" from C.	116,200	48,000	55,700	18.5	35.7	85,100	26,500	12.0	16.7	237 to 241	48,000		.40	
													3" from C.	121,500	60,600	62,300	19.5	43.6				18.2					
													3½" from C.	122,000	63,000	63,700	20.0	48.1				15.8					
													Average	119,900	57,200	60,550	19.3	42.4				16.9					
									1" sq.			Trans.	1" from outside	119,250	55,850	58,250	14.2	17.3									
									Quadrant 11" long	1300		Longitudinal	1" from C.	107,500	50,000	53,700	22.0	30.4	79,100	26,800	12.0	16.4	215 to 229	46,500	34,000	.42	.31
													2" from C.	114,500	50,500	53,500	22.5	40.6				16.7					
													3" from C.	110,700	55,800	57,500	25.0	49.2				16.7					
													3½" from C.	113,500	52,500	56,200	22.0	45.8				12.8					
													Average	109,800	51,950	55,200	22.9	43.8				15.6					
									1" sq.			Trans.	1" from outside	107,750	52,700	53,700											

• • • The averages presented above in Table III represent the mean values of two or more tests where the conditions were identical. In the case of the larger sections, the full test data are reproduced since the physical properties vary widely at different sections due to mass effects in quenching. Tabular data on the creep and strengths of many of these steels at elevated temperatures will be presented in next week's issue.

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Carbide Milling of Steel Features ASME Annual Meeting

. . . Among the 150 papers presented at the annual meeting of the American Society of Mechanical Engineers, held in New York, Nov. 27 to Dec. 1, were a number of papers relating to the milling of steel with carbide cutters. Data on the influence of reduced temperatures in cutting oils and other phases of machine shop practice were also reported.

HEAVY roughing work on large parts is a relatively new field for carbides, opened up through the use of mechanically held carbide cutting blades, according to W. L. Kennicott, chief engineer, Kennametals, Inc. He traced the history of the development of solid carbide blades mechanically held in standard or special tool holders for use both in the form of lathe tools and milling cutters.

Citing the advantages of solid cutters over the conventional brazed tip, he indicated that the solid carbide tool can be reground many more times, the shank material is not ground away and hence it remains at its original strength; strains due to the difference in thermal expansion rates of steel and carbide are eliminated, an important factor on the larger sized tool, and finally, grinding is simpler as the differential expansion problem is no longer a factor there either.

Use of solid carbide blades on heavy roughing work has been made possible through improvement in the physical properties of cemented carbides over the past few years. Break strengths have been almost doubled, permitting the overhang of blades beyond the steel seat and mechanical clamping of various types. A unit price reduction of 92 per cent over the last four years has also been a factor in this development.

Investigation of clamping pressures necessary to hold the carbide tip in place in a carefully machined recess brought out the fact that no clamp at all was needed on continuous cutting, once the cut was started.

Heavy duty tools using mechanically held tips were primarily developed for machining heavy alloy forgings and armor plate where the work was such that it could not be rotated rapidly due to out-of-balance, nor were the higher speeds available in existing machines. Instead of using high speeds and low feeds on these jobs as in ordinary carbide practice, the speeds run from 40 to 150 ft. per min. and the feed from ⅛ to ¼ in. per rev. on turning or boring, with depths of cut ranging up to ¾ in. Use of heavier feed eliminates the need for chip breakers, increasing the rate of metal removal for a given horsepower.

Use of solid carbide blades and double negative rake millers has resulted in particularly outstanding results, according to Mr. Kennicott. In large milling cutters the proportion of carbide to body is less favorable than in a single point tool and the milling cutter must be heated repeatedly in brazing instead of only once. Hence the factor of differential ex-

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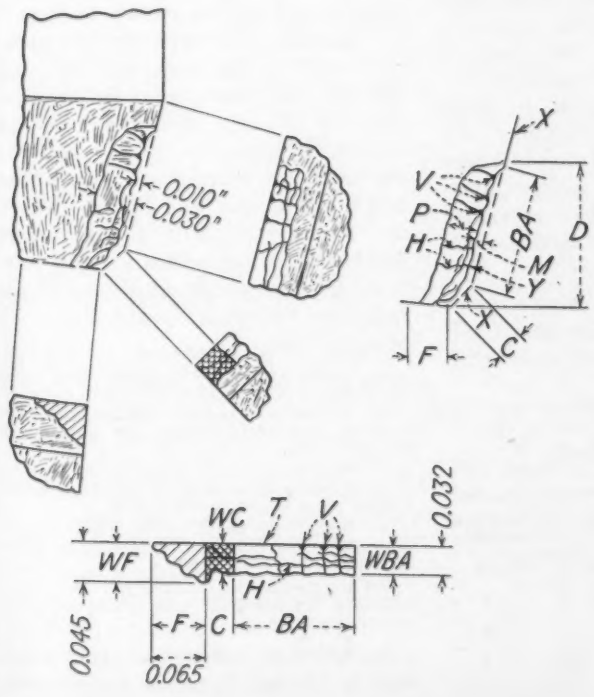

FIG. 1—Characteristics of wear around cutting edge of carbide tip used in milling steel with negative angles.

D—Depth of cut
BA—Bevel angle
C—Chamfer
F—Length of wear land on face of cutter
WBA—Width wear land on bevel angle
WC—Width wear land on chamfer
WF—Maximum width wear land on face
T—Face of cutting tooth
X—Original outline of cutting tooth
Y—Outline of tooth after breakdown occurred and wear was recorded
V—Points of breakdown
H—Fair hair-like lines. Many of these only become noticeable at 20 magnifications
P—Width of crater
M—Amount cutting edge wore back up to the time breakdown occurred.

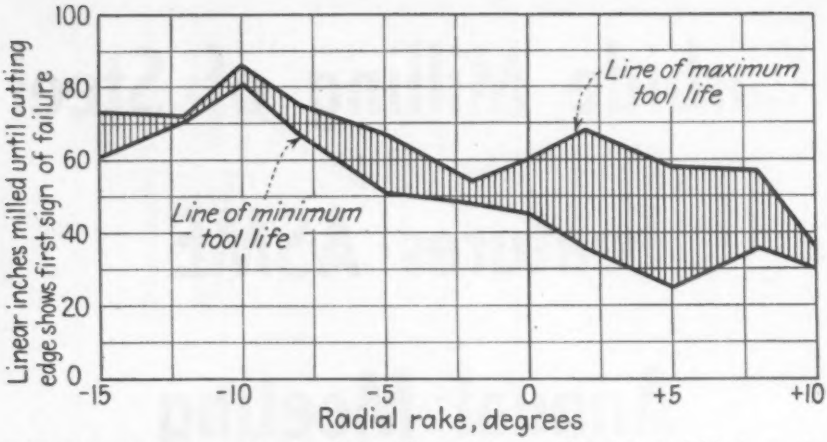

FIG. 2—Radial rake angle of carbide milling cutter as related to tool life in number of inches of SAE 1045 steel milled before first breakdown of tips. Maximum and minimum values for any one angle shown.

pansion strains becomes much more important in multi-blade cutters.

The speaker illustrated a slotting type of cutter in which solid carbide blades were locked in position with radial wedges. Taking a cut over ½ in. wide, ¾ to 1½ in. deep and 9 in. long in an aircraft wing hinge, this type of cutter gave an average life between grinds of 32.3 in. The same theory has also been applied to face mills in which the carbide blades are held in place by hardened wedges. In this case the solid blades are lapped on top and bottom to maintain flatness and control the wedge angle. On a straddle milling job 8 in. diameter cutters of this type have been safely run at 200 r.p.m. (approx. 400 ft. per min.) with 40 in. per min. feed.

These same solid carbide blades are at present being applied to half side mills, end mills of the larger sizes, slab mills and special cutters. In all cases the solid blade design has resulted in more consistent performance when applied to heavy duty cutting of steel.

Taking issue with the speaker, Malcolm F. Judkins, chief engineer, Firthite Div., Firth-Sterling Steel Co., pointed to the added cost and complexity of mechanical fittings of carbide blades. He maintained that by directing the brazing heat into the carbide, which is thermally inert, and heating the shank to a minimum, thermal strains in the braze are kept to a minimum. Parenthetically, this recommendation is in opposition to generally recommended practice in which the torch flame is directed against the bottom of the shank and is kept away from the tip.

Several others pointed out that erratic performance of carbide is primarily due to poor practice in brazing or grinding. Setting the tip against a single shoulder is to be preferred over the usual design in which the tip is brazed into a recess. It was also pointed out that where brazing is used, the design should be such that grinding is confined to the immediate cutting edge.

Optimum Rake Angle

Tests made in milling annealed SAE 1045 steel heat treated to a hardness of 190-210 Brinell with a single fly cutter indicate that the longest cutter life was obtained with a 10 deg. negative radial rake angle combined with a 10 deg. negative axial rake. The tests were made in the laboratory of the Carboloy Co., Detroit, and were reported by Fred W. Lucht, development engineer. In each run, the setting of the tool was such as to maintain a uniform axial rake, but the radial rake was varied from 15 deg. negative to 10 deg. positive.

The cutters were all single point tools tipped with Carboloy grade 78B and in the early runs were mounted in an 8 in. diameter face milling cutter. Performance was found to be extremely erratic for feeds beyond 0.006 in. per tooth and at feeds of 0.010 in. and over, the spindle clattered and the machine, a No. 5 Milwaukee, developed a tendency to "dance" on the floor. This erratic performance was completely overcome by enshrouding the cutter in a steel flywheel, the combination weighing 255 lb.

Throughout the tests, a speed of 238 r.p.m., corresponding to 498 ft. per min., was used and a feed of 2 in. per min. or 0.0084 in. per tooth was maintained. Previous experiments had indicated that this is the minimum feed per tooth which gives good cutter life, and on multi-tooth cutters this feed can be obtained on most present day milling machines and still keep within the power capacity of the machine. The depth of cut was maintained at 5/32 in. since it represents the average depth which will cause wear similar to that obtained by machining deeper cut.

As soon as a well defined deep blue line parallelling the length of the chip appeared, indicating the first breakdown or chipping out of the tool's edge, the run was stopped. With a 20-power magnifying glass the exact nature of tool wear was determined, including such factors as width of the land wear along the bevel angle, chamfer and face; the distance the cutting edge has worn back from the original bevel outline, and the width of the crater on the face of the tooth. Such an analysis of tip failure is shown in Fig. 1.

At the end of the series of runs, the results of the tests were graphically portrayed, as shown in Fig. 2, by plotting the number of linear inches milled by each tool up until the time the cutting edge first showed signs of failure. One line was then drawn through the points showing the maximum number of inches milled and a second line was drawn through the points indicating the minimum number of inches milled in each case.

Under the specific conditions of the test, the following conclusions have been reached:

1. A 10-deg. negative radial rake gave the longest cutter life for each run.
2. A 12-deg. negative radial rake gave shorter but more consistent cutter life for each run.
3. Negative radial rakes greater than 12-deg. gave still shorter cutter life, together with wider fluctuations.
4. Negative radial rakes less than 10 deg. gave the shortest cutter life. Wide fluctuations were noted.
5. Minimum cutter life, together with extreme fluctuation, was obtained with positive angles.

In order to determine the reason why a 10-deg. negative radial rake

TABLE I—Recommended Milling Cutter Angles for Steel

Type of Mill	Work Material	Axial Rake Deg.	Radial Rake Deg.	Corner Angle Deg.	Corresponding True Rake
Face or side	Hard steel (or general purpose)	−10	−10	30 to 45	13 to 14
Face or side	Soft steel (under 180 Brinell)	− 5	− 5	30 to 45	− 7
Slotting	Hard steel (or general purpose)	− 5	−10	....	−10
Slotting	Soft steel (under 180 Brinell)	0	− 5	....	− 5

gave the longest cutter life, the relationship of the negative radial rake angle on the face of the tool was carefully checked with the outline of the work at the point where the cutting edge along the bevel angle entered the cut. It was found that the best operating conditions will be obtained when milling steel with carbides if the face of the tooth first contacts the work at a distance back from the cutting edge equal to the feed per tooth and at a distance from the face of the cutter equal to the depth of the cut.

High Speed Milling

Summarizing further researches and actual shop experience in high speed milling, Hans Ernst, research director, Cincinnati Milling Machine Co., presented some general recommendations on speeds, feeds, cutter angles and efficiency of metal removal for high speed carbide milling of steel, cast iron and aluminum. The chart, Fig. 3, shows recommended cutting speeds for materials of various hardnesses. In this connection, Mr. Ernst cautioned that any new job be started with the average recommended cutting speed. If the cutter sparks prematurely, the cutting speed should be reduced. The lower speeds are also favored where maximum cutter life is desired, also if carbide edge begins to fail rapidly by abrasion. No job should be started without first determining the hardness of the material as a speed that is safe for a soft material may destroy a cutter almost instantly on hard material.

The following feeds per tooth are recommended for milling steel:

Type of Milling	*Feed per Tooth, In.*
Face	0.006-0.012
Slide or straddle	0.008-0.012
Slab	0.008-0.012
Slotting	0.006-0.010
Saw	0.003-0.006

The maximum feed which can be used is determined either by the power available in the machine, the rigidity of the cutter, work and fixture or the finish required. It should be remembered that for shallow slotting cuts the maximum thickness of the undeformed chip may be only 10 to 50 per cent of the feed per tooth and hence the upper limits of feed can be used. If carbide begins to fail rapidly by abrasion, the feed per tooth should be increased; if the carbide begins to crater too rapidly, however, the feed per tooth should be reduced.

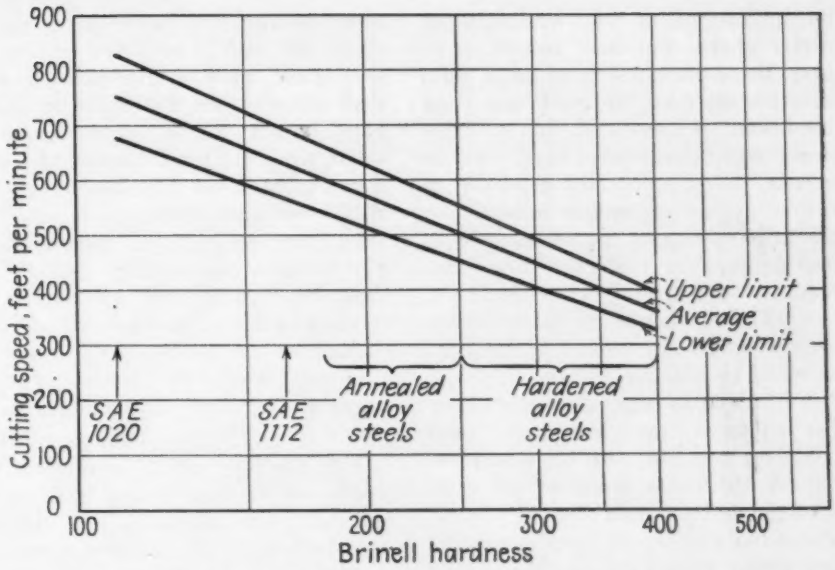

FIG. 3—Recommended cutting speeds for milling materials of various hardnesses. Latest data from Cincinnati Milling Machine Co.

Recommended milling cutter angles for steel are given in Table I.

For average grades of cast iron and Meehanite with a Brinell hardness range of 150 to 220, the cutting speed recommended is from 450 to 300 ft. per min., depending on the hardness and uniformity of the material. For chilled castings where the hardness exceeds 300 Brinell, the cutting speed may have to be reduced to about 200 ft. per min. to obtain a satisfactory cutter life.

For all types of cuts, recommended feed per tooth for cast iron and Meehanite is 0.008 to 0.020 in., with the high limit favored wherever possible.

Recommended milling cutter angles for cast iron and Meehanite are as follows:

Axial rake, deg.	+ 3 to + 7
Radial rake, deg.	+ 3 to + 7
Corner angle, deg.	30 to 45
True rake, deg.	+ 4 to + 9

For aluminum and magnesium alloys, positive rake angles are recommended in practically all applications. Only in the case of some of the more abrasive aluminum alloys does it seem helpful from the standpoint of tool life to resort to negative rake. Cutting speeds from 3500 to 12,000 or even 15,000 ft. per min. are now in use on aluminum alloys, the selection being usually determined by practical considerations other than chip formation, such as cutter vibration (in the case of thin saws), nature of work and mounting, and spindle bearing design. Wherever possible, however, the cutting speed should not be less than about 6000 ft. per min.

Machine Selection

While in certain instances it now becomes possible and economical to employ heavier machines of larger horsepower, this is not a general requirement, as in many cases production can be materially increased with existing equipment, Mr. Ernst said. The maximum usable horsepower is determined not by the machine but

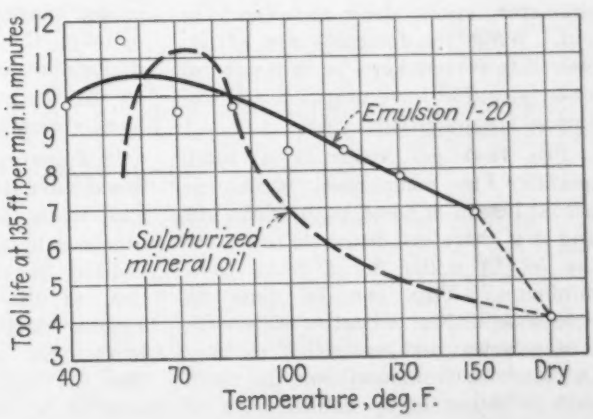

FIG. 4—Variations in tool life, at 135 ft. per min., for an 18-4-1 high speed steel cutting tool with variations in temperature of a sulphurized mineral oil and a 1:20 emulsion of soluble oil.

by limitations of the workpiece or cutter shape. For best results, however, these machines must be of rigid construction and in good operating condition. As most of this work is done with relatively high spindle speeds, it is generally possible to utilize appreciably more power than the basic rating of the machine, without damage to gears or other elements of the driving mechanism.

Flywheels should be used whenever practical and should be mounted as close as possible to the cutter.

With carbide cutters, down milling (or climb milling) should be used wherever possible, with the workpiece fed in the same direction as it is tending to be moved by the cutter. Maximum rigidity of work mounting and cutter should be sought. Extra jacks and clamps are often necessary to provide additional rigidity to the work and massive fixtures are required. Cutters should be mounted on large arbors and arbor supports should be placed close to the cutter.

Whenever possible, the work should be removed before returning to the starting position. If it is necessary to return to the starting position, a high feed or preferably rapid traverse should be used, making certain that the cutter rotates during the return motion.

Steel and cast iron should be milled dry. Compressed air is useful to blow the chips off the cutter. In milling aluminum an abundant supply of cutting fluid can be used as a means of washing away the chips.

Down vs. Up Milling

Continuing his analysis of the milling process, which he had first presented at the 1940 annual meeting of the society, Dr. M. E. Martellotti, research engineer, Cincinnati Milling Machine Co., analyzed the kinematics of chip formation in conventional (up) and climb milling and presented mathematical formulas for determining the maximum thickness produced under any given conditions of cutter diameter, speed, feed and depth of cut. While the formulas are too involved to review here, certain general principles that have practical application are summarized.

The feed per tooth is a small quantity in comparison with the actual length of tooth path in the cut and it is therefore desirable to reduce the length milled by a tooth to a minimum. This can be done by proper selection of cutter diameter, feed per rev. and method of milling. Dr. Martellotti showed that the tooth path is longer in up milling than in down milling, and hence a saving in cutter life can be obtained by use of the latter method. He pointed out that although the difference in tooth path length for a single chip is small, when the total number of tooth engagements and number of pieces milled are considered, the saving in milled surface may be considerable. For the same reason, the depth of cut should be kept as small as possible in relation to design and method of fabrication of the part being milled.

Summarizing this aspect of the problem, Dr. Martellotti stated that:

1. For any given cutting speed: (a) As the feed rate is increased, the length of surface milled per tooth and per piece decreases, and (b) in down milling, a progressively shorter surface is milled than in up milling.

2. For any given feed rate: (a) As the cutting speed is increased, the length of surface milled per tooth and per piece increases, and (b) the difference in surface milled in favor of down milling decreases.

3. The length of surface milled per piece and per tooth can be maintained constant by changing both the cutting speed and the feed so that their ratio remains constant.

4. Down milling shows a greater saving in milled surface at higher feed rates.

Comparing the curves (arcs of trochoids) generated by a tooth in both processes of milling, Dr. Martellotti indicated that a flatter arc is obtained in up milling than in down milling and on this basis a better finish will result in up milling since the "peaks" will be smaller. In addition to tooth marks produced from the geometry of the cut, a surface milled with a plain milling cutter may show periodic variations having a wavy appearance as a result of eccentricity of the spindle and the presence of high teeth. These are called revolution marks. The height of the tooth marks can be reduced by increasing the radius of the cutter and decreasing the feed per tooth. Revolution marks can be prevented by grinding the cutter teeth within close limits and making sure that the run-out of the cutter and arbor is kept to a minimum.

In down milling, there is the additional advantage that both revolution and tooth marks are usually obliterated by the material of the chip yielding in almost tangential direction as the tooth approaches the finished surface of the work. The surface has a dull appearance, free from the characteristic parallel markings of a surface produced in up milling. On the other hand, owing to fragments of built-up edge left on the surface in down milling, the final surface produced is rougher than in up milling where the built-up edge forms on that part of the work that is milled off in subsequent cuts. This is not so in up milling.

Approach Angle Different

There is a fundamental difference between the two methods of milling in the manner in which a tooth engages the work. In down milling, for instance, a tooth engages the work on the unmachined surface at a distance equal to the feed per tooth from the path generated by the previous tooth and the thickness of chip in the early stages of formation is considerably greater than in up milling, where a tooth engages the work in an almost tangential direction at the start of the cut. With a constant depth of cut, the angle of approach of cutter to work increases with the feed per rev. in down milling and decreases in up milling, although the amount of change is small in both instances.

In down milling, as a tooth begins to cut, the load (generally normal to the cutting edge) produces compressive stresses on the cutting material while in up milling, on account of the nearly tangential direction of tooth engagement with the work, bending stresses result on the cutting edge. The load conditions in down milling are particularly advantageous when using high feed rates and in high speed milling with carbides.

Comparative data on power consumed by both milling processes indicates that for corresponding values of feed rate and different depths of cut, the *total* power input into the machine is higher in up milling than in down milling, although the power required by the cutter alone is higher in the latter case. This condition may be explained by the fact that in down milling, the component of the cutting force acting parallel to the table in the direction of the feed helps propel the table, thus producing a corresponding decrease in the power required to feed the table. Measured in cubic inches per minute per horsepower, the efficiency of metal removal is higher in down milling than in up milling.

In conclusion, Dr. Martellotti summarized these advantages of down milling: Possibilities of simplified fixtures and the milling of parts that cannot be easily held; milled surface not affected by revolution marks and hence more easily polished; lower

(*Continued on Page* 156)

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• Pricing of postwar passenger cars is now under examination, with manufacturers preparing cost analyses for OPA . . . Reemployment of veterans is subject of added developments.

DETROIT—With questionnaires on their desks from OPA calling for comparison of direct and indirect costs of labor and material as between 1941 and today, automobile purchasing agents are canvassing their suppliers to get better ideas than ever before as to the extent of the price rises on their components.

They maintain that their own records show steel prices are up anywhere from 1 to 2 per cent since early 1941. The fact that an increase comes despite the price freezing is due to application of extras.

Cotton for upholstery is up some 200 per cent. Tires are up 40 per cent, and that amounts to about $20 per car, making the increase one of the most significant in the whole list. Malleable iron and gray iron castings, of course, are the highest priced in their history today, and the same goes for some forgings.

On the more optimistic side, one glass company is reported to have advised its auto company outlets that it does not plan a price increase. One carbureter maker, too, is hoping to sell its product at prewar prices. This particular factory has learned a great deal about mass production applications in its war assignments, and may stand out from the crowd in its decision.

In all, it seems reasonable to assume that materials will be up somewhere between 20 and 25 per cent as compared with the prevailing rates for the 1942 models. This increase alone could account for a 10 per cent increase in car prices should the passenger car makers be minded to pass it along.

The other major increase in costs is in labor, and it seems reasonable to assume that in the Detroit area the advance is about 30 per cent. Inasmuch as labor accounts for somewhat over one-third of the wholesale price of an automobile, this would be grounds for addition of another 10 per cent to the bill. The combination of labor and material price increases, therefore, is somewhere around 20 per cent.

Whether the Office of Price Administration will allow this increase is doubtful; on present grounds it does not appear that so large an allowance will be made. OPA is firm in the viewpoint that only direct and indirect materials and labor costs should be allowed, and perhaps not all of them. This formula makes no provision for enlarged fixed expenses, extraordinary burdens at the start of a model year, increases in front office salaries, and other such applications. The OPA viewpoint is that larger volume will compensate for the reduced overall profit margin, but automobile makers point out in rebuttal that during the limited production period an exact opposite of that situation will prevail.

THE auto people hope to persuade OPA that their own intense competition is the best possible measure for regulation of prices. They maintain that there is no great point in setting ceiling prices on cars, whether at 1941 levels or any other levels, because it is a simple matter to cheapen the innate quality of the car by reducing specifications on parts, etc., thereby bringing the price into line at the expense of the customer's welfare. This viewpoint undoubtedly has merit. At the same time, there is something to be said for OPA's stand that unless ceilings of some sort are applied, a runaway market may ensue in the limited production period.

In this situation the parts and accessory makers are extremely worried. The figure that OPA will rigidly restrict the amount of price increase permitted to the automobile makers, and that in their resultant position the passenger car purchasing agents will simply redouble their normal pressure on their suppliers for lower prices and continued quality.

One proposal made in a series of confidential meetings by OPA with the parts makers has been that each of the 45 parts companies which supply approximately four-fifths of the equipment to the automobile trade should appeal to Washington for the price advances they figure necessary. Each case would be settled individually. The flaw in this, of course, is that it makes no provision for the 850 other suppliers in the automobile industry, and probably their situation

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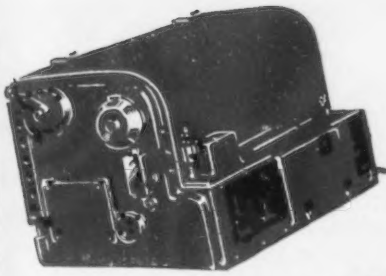

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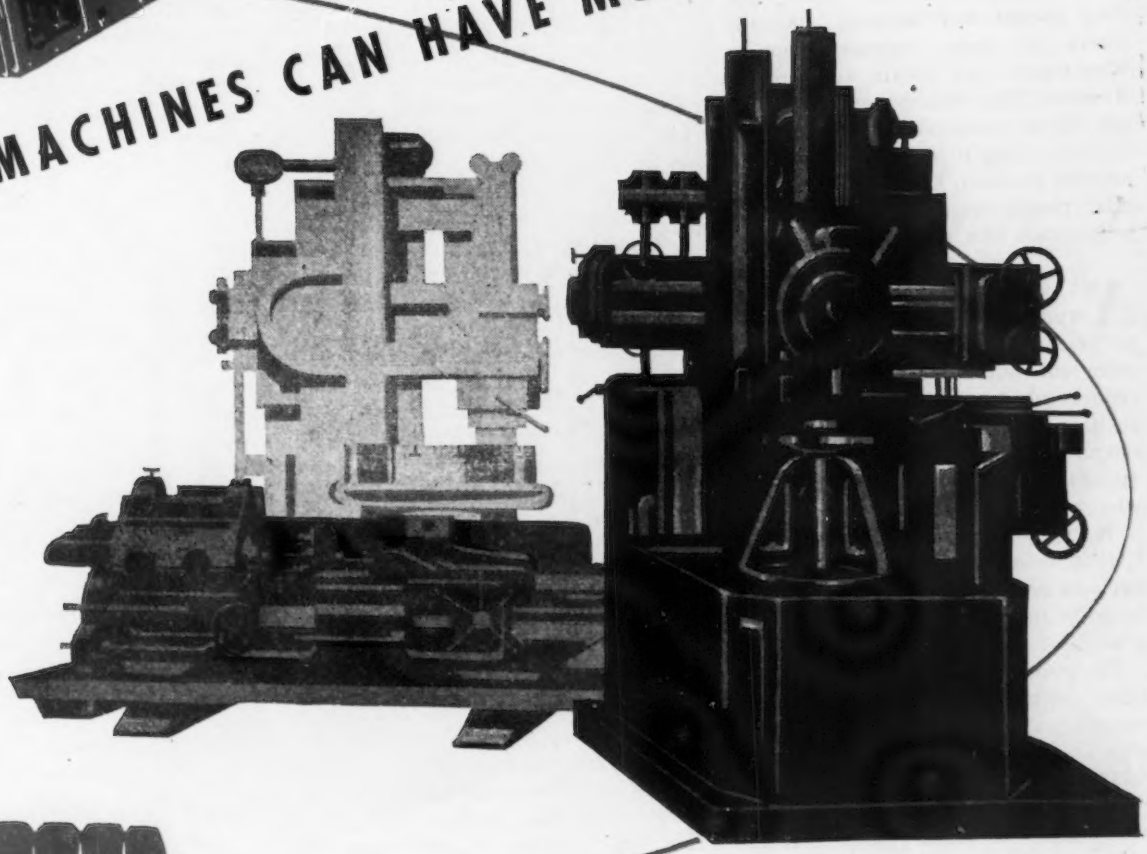

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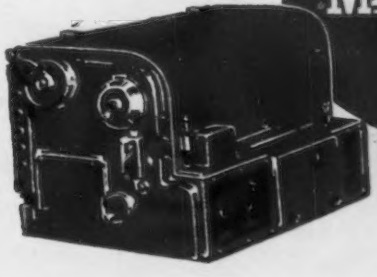

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needs attention more than those of the large manufacturers.

Another version of this is to settle on an average price increase for all parts, right across the board, and then permit any injured manufacturers to make representation to Washington and obtain adjustments. However, this would merely serve to put parts companies which need a higher ceiling in extremely bad competitive position, and none of the supplier people want to go along on a proposition like that.

AN auto industry committee studying the problems incident to re-employment of veterans has come out with a cautiously worded report which appears to favor the position taken by General Motors Corp. THE IRON AGE, Nov. 23, 1944, (p. 68) which puts workers and soldiers who went to their respective posts in industry or the services after May 1, 1940, on an equal plane, with management retaining the choice to choose between individual job applicants on a basis of merit and ability.

The report points out that current labor contracts either do not touch the matter of veteran re-employment at all, or handle it in a manner unsatisfactory to the returning veterans. "Under the circumstances," the report reads, "it would appear that the only immediate and effective means by which an equality of job opportunity can be obtained for the veteran with no previous employment record would be insertion of a new seniority clause in the labor contract of individual companies. Thus, existing contracts, which protect war workers' seniority to the detriment of veterans, could be liberalized to give the veteran equal employment opportunities with war workers hired subsequent to May 1, 1940."

The committee further recommends special consideration for veterans with service acquired disabilities. Another clause, it is pointed out, might be inserted in labor contracts whereby disabled veterans could be placed on any job suitable for them and allowed to hold the selective job regardless of the relation of their seniority to that of other employes.

The Detroit Regional War Labor Board, meanwhile, has ruled in a case involving N. A. Woodworth Co., that the seniority of any employe with the company six months before he entered the services, now returning to work, should be cumulative for the total time previously worked plus the time spent in the service. This is not a major finding; all permanent employes are given the right under the selective service law to return to their previous employers except under exceptional conditions; and the board merely confirms into fact the understanding in many labor contracts that time spent in the service shall count as time on the job in periods of layoff and hiring.

A working agreement on veterans' senority has been set up at Packard Motor Car Co., without benefit of contract. Recent layoffs involving around 5000 employes, more than 15 per cent of the total Packard working force, have by-passed about 500 veterans of this war, none of whom had been employed by Packard when they went into the service, which left them without protection under Selective Service rules.

Negotiations between Packard and Local 190 of the CIO United Auto Workers Union arranged for the retention of the veterans. The deal followed somewhat the "model clause" drafted by the UAW in its September convention, which grants seniority to veterans equivalent to time spent in the service. Accordingly, all men thus far continued on the payroll at Packard have seniority, built on their factory time plus service time, greater than the standing of those laid off, most of whom had less than six months in the factory.

Packard, accordingly, becomes the first company in the industry to go along with the UAW concept. The company is probably in good position to do this, inasmuch as the 12,000 original Packard men employed on automobile manufacturing before the war have dwindled to 4600, so the remaining 30,000-odd now on war work have no more than three years' seniority, putting veterans in good positions for jobs. Also, because Packard's post-war plans are definitely on the ambitious side, calling for employment in excess of 20,000 men, the problem of integrating returning veterans into jobs does not appear as considerable as in the cases of other companies.

Over Five Million Clerical Operations Saved Thru New Plan

Harrisburg, Pa.

• • • **The opportunity of saving** more than 5,000,000 separate clerical operations will be offered Pennsylvania employers who are furnishing Unemployment Compensation wage data when the new list reporting plan becomes effective Jan. 1, 1945, according to a statement by William H. Chesnut, secretary, Department of Labor and Industry.

Secretary Chesnut explained that under this new plan when an employer makes out his federal report on old age and survivors insurance, a carbon copy of this report will be accepted by the commonwealth in lieu of the millions of individual wage reports that have previously been required annually.

This step is part of the department's program to cut red tape and also produce an economy of operation for employers already burdened with much reporting. Another advantage seen in this new plan is the assurance that it gives of paying all claims for unemployment compensation promptly and thus avoiding any of the delays that were caused by the old system.

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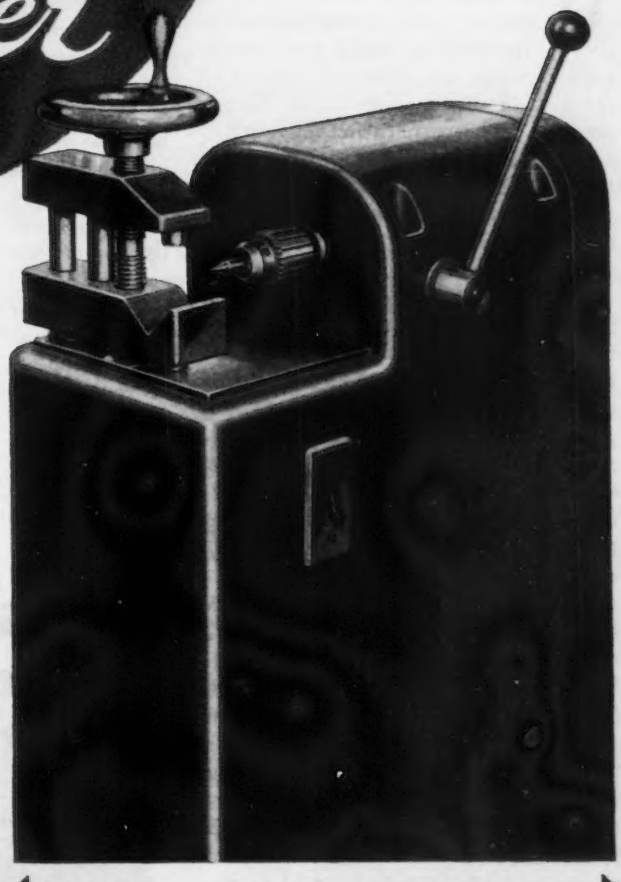

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L. W. MOFFETT

• Defense Plant Corp. trying to get contractors to begin predetermination work on machine tools and other industrial equipment... Schools established.

WASHINGTON—Defense Plant Corp. is now trying to get contractors to begin predetermination work on machine tools and other industrial equipment so far as possible. The corporation has started schools in war contractors' plants in Springfield, Mass., Detroit and Cincinnati where contracts have been terminated which present problems in storage and removal.

The schools are for government and industry technicians to learn the practical application of uniform rules for preparation of forms, cleaning, painting, greasing, skidding, removal and storage and transportation of government-owned equipment. The rules have been derived from Army Ordnance Instructions (PS 3003) dating back to the last war and which were revised in August.

The reason for beginning the work now is that DPC wants all contractors to be familiar with what they will have to do with that equipment which they do not wish to purchase when terminations become general. This will result in a saving of time during reconversion and a saving of money to the government if equipment is properly handled when removed from plants whether it is to be sold or retained by the government for standby purposes.

The widest publicity should be given to the new uniform procedure, DPC feels, because lack of uniformity in these matters in the past has resulted in a great deal of confusion and waste of time. Contractors who have worked for both the Army and Navy have in the past packaged machinery and prepared it for storage or shipment under the rules set up by one service or the other and have had to do the work over since the handling of Army equipment did not meet the requirements of inspectors because of being prepared under Navy regulations, or vice versa.

* * *

DPC has done a good job of reducing the complicated language of the Ordnance regulation to plain English and has set forth about 25 steps a contractor should follow in getting rid of machinery he does not own and doesn't want to buy. Detailed skidding instructions have been laid out, with illustrations of the types of crating which has to be done for various types of equipment.

A 25-page warehousing guide has been prepared, showing whether particular items should go into open storage, or whether in heated or unheated warehouses. A list of approved suppliers furnishing preservative materials under government specifications has also been drawn. Contractors must use these materials or their equals. Manufacturers of corrosion preventive compounds can get on the official list upon meeting government test specifications.

The uniform rules provide that machinery should be cleaned with a particular kind of solvent. Old oil should be replaced with storage grease and coolants should be drained out and be replaced by storage oil. Places where paint has worn off should be retouched.

Then the equipment may be broken loose from its foundations; wires and piping should be removed, and all sliding parts locked. All removable parts should be packed after cleaning, finger-print remover should be applied over-all and a heavy coating of protective grease put on the outside of the equipment. All openings should be covered with wax-covered fabric or tape. The DPC inventory number should be stenciled on the machine and parts, which are removable.

* * *

WHEN equipment is to be shipped, the rules require that it be blocked to the floor of the car and the external coating reapplied whenever removed through handling. The company representative should have the packing inspected and passed by a railroad official, and secure a receipted bill of lading.

Detailed instructions are also provided for the filling out of forms, tags and envelopes needed to accomplish the transfer or storage of the machinery. Costs involved in the procedure will be borne by the government, it is provided under the Joint Army-Navy Termination Regulation.

* * *

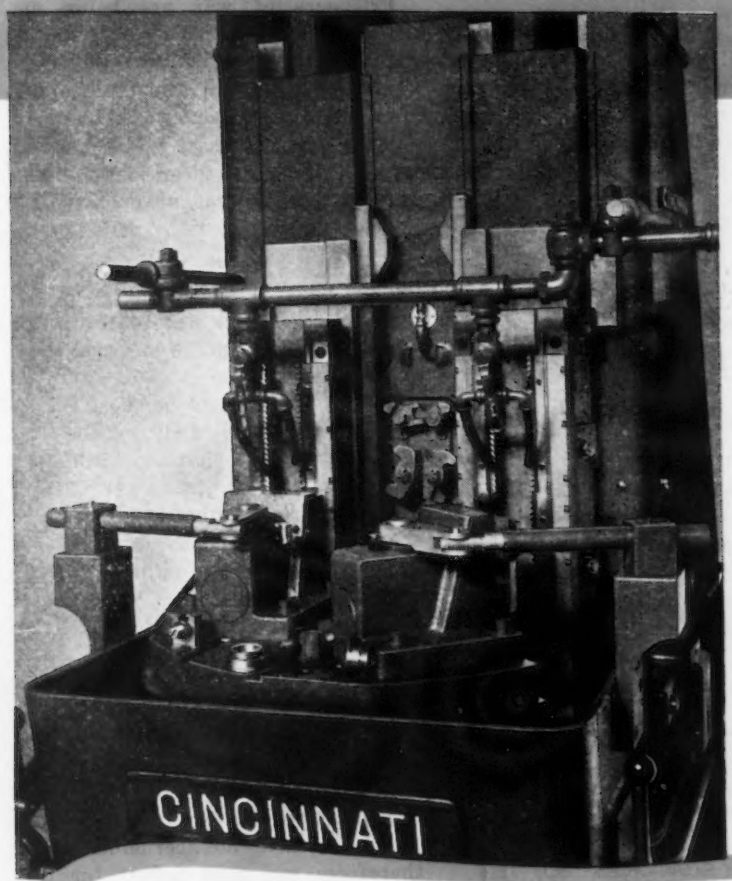
Lionel Noah, assistant chief in charge of the Navy's Industrial Readjustment Branch, said recently that on Nov. 1 the Navy had in process 2430 terminations valued at $2,763,-

SUPERFORT BOMBS—*Ground crew members ready bombs for loading into one of the Superfortresses at the central Pacific base on Saipan in the Marianas group. Note the double bomb-bay doors open on the ship.*

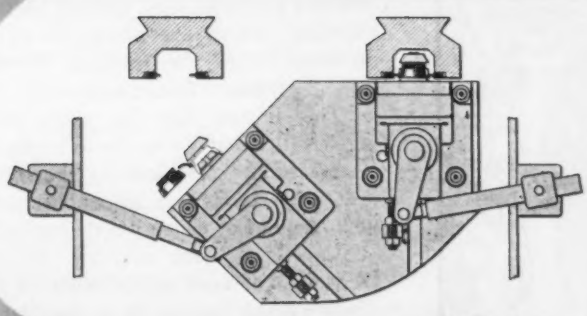
JUST REMOVE BROACHED PART— AND DROP IN ANOTHER

it's as simple as that

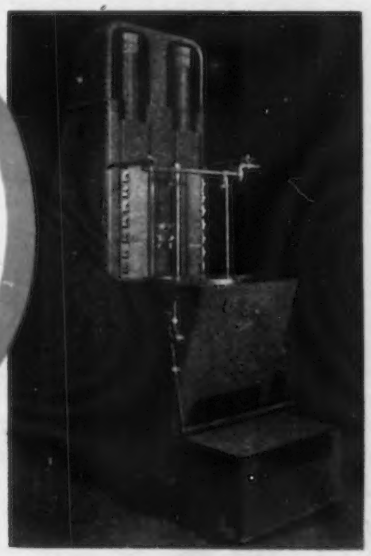
NO HAND CLAMPING OR MANUAL LOCATING REQUIRED WITH THIS CINCINNATI ENGINEERED EQUIPMENT



The exceptionally high production on this job, and the ease with which it was handled, may be attributed largely to the efficient fixtures designed by CINCINNATI Application Engineers. The equipment: A CINCINNATI No. 3-30 Duplex Vertical Hydro-Broach with automatic clamping fixtures. The operation: Broach two wrench slots. The operator simply removes one finished part and drops in a new piece to replace it. This is the only manual part of the entire operation. A V-block with a back taper locates the part centrally, and a cup-shaped clamp at the front of the fixture clamps the part back against a locating plate. ¶ This setup was developed by CINCINNATI Application Engineers and provides a fast and economical means of machining two wrench slots in a circular part. Talk over your broaching or milling jobs with our engineers. They may be able to work out a more satisfactory method of handling your work.



Simplified drawing showing how the parts are automatically located and clamped, prior to the down stroke of the ram.



CINCINNATI

Right: CINCINNATI *No. 5-42 Duplex Vertical Hydro-Broach. Catalog M-894-2 gives complete specifications. For a brief description, look in Sweet's Catalog File.*

THE CINCINNATI MILLING MACHINE CO. CINCINNATI, 9 OHIO, U.S.A.

TOOL ROOM AND MANUFACTURING MILLING MACHINES . . SURFACE BROACHING MACHINES . . CUTTER SHARPENING MACHINES

000,000. The greatest part of these, some $2,333,000,000 worth, have not had claims filed on them by the 2074 contractors involved. Claims have been filed for only $430,000,000 by 356 contractors.

Of the entire amount, more than $1,000,000,000 were terminated in the previous three months. Largest cuts have come in the destroyer escort program. Terminations have been substantial in submarines, torpedoes and 20 mm. guns and ammunition.

The only programs of the Navy which are lagging are rockets and 40 mm. ammunition. Navy termination officers are trying to stimulate the filing of claims, and to get prime contractors to instruct subcontractors in termination procedures.

* * *

Senator Mead, Democrat of New York, Chairman of the Senate Committee, which bears his name, has asked RFC to review surplus property sales by auction to make sure that auctioneers fairly exercise their discretion in selling, that no individuals are able to buy consistently at bed-rock prices while others must pay more. RFC has promised that it will do this in the future.

* * *

When Lieut. Gen. Brehon B. Somervell testified before the Mead Committee on Dec. 4 he told members that he has had a hard time convincing officers in custody of surplus property that it should be declared surplus. He said that this unwillingness to get rid of such property could be compared with a housewife's tendency to store in the attic things which are no longer needed.

General Somervell also said that when officers make mistakes in selling surpluses for low prices and are scolded by Congress and the press, the scolding has a tendency to make every officer in charge of disposal try to get the highest possible price for goods.

* * *

Senator Mead has proposed that heavy industries be removed from the WMC's controlled referral program and be permitted to go into the open market for labor. The Senator implied at a recent hearing that WMC's upgrading of unskilled workers and refusal to refer them to the jobs in heavy industries where manpower shortages are the worst are the basis for his suggestion.

He said that an unskilled worker who is employed for two or three months in the aircraft industry, for example, is usually permanently upgraded by WMC, and consequently is not sent back to his old job which may have been in a foundry or other equally arduous industry.

* * *

Prisoners of war are being employed in the lumbering and canning industries, but not in war industries generally. A War Department representative has recently said the principal reason is that WMC has not referred them for these jobs and also organized labor has strenuously objected.

Tax Statement Said To Aid Speeding Of Contract Settlements

Washington

• • • **In a joint statement** issued recently by high-ranking government officials it was stated that the recent ruling by the Commissioner of Internal Revenue clarifying the tax effect of "no cost" settlements of terminated fixed-price war contracts will speed the settlements of such contracts.

It was declared to be most important for industry and for the contracting agencies that the backlog of unsettled war contracts be cleared away before terminations occur on the defeat of Germany or Japan.

The statement was issued by Secretary of the Navy James V. Forrestal, Undersecretary of War Robert P. Patterson, Vice Admiral Emory S. Land, Maritime Commission Chairman, and Robert H. Hinckley, director of the office of Contract Settlement.

"The Commissioner's ruling brings out the fact that contractors who waive their right to termination compensation have no accruable income therefrom and may deduct for Federal tax purposes any related costs or expenses which are allowable as deductions under the Internal Revenue Code," it was pointed out.

"This means that the same treatment will be given to these items for renegotiation purposes to the extent that such items are allocable to the performance of renegotiable contracts.

"This statement clarifies the tax treatment of such settlements so that a contractor is now in a position to decide definitely whether in the light of his particular situation he may utilize the no-cost settlement procedure to dispose of his backlog of unsettled terminations. The no-cost settlement procedure, where appropriate, greatly simplifies the contractor's settlement problems since it makes unnecessary the preparation and filing of detailed claims.

THE BULL OF THE WOODS — BY J. R. WILLIAMS

HOLD IT, AL! I'LL RUN THAT CENTER IN FOR YOU!
THAT'S A GOOD ONE! THE GUY WHO'S ONLY HALF WAY UP TH' LADDER HAS GOT MORE CHEST AN' DIGNITY THAN TH' GUY WHO'S AT TH' TOP-- AN' HE DON'T HAVE HALF AS FAR TO BEND DOWN!
BRAINS IS TH' SAME AS ANY OTHER RACE! TH' GUY WHO'S FAST HAS GOT LOTS O' TIME TO LOOK BACK AN' SEE WHUT'S HAPPENIN' TO TH' SLOW ONES -- BUT TH' HALF-FAST ONES CAN'T SEE ANYTHING BUT TH' FAST ONES' SHIRT TAILS!
REDRAWN BY REQUEST
J.R.WILLIAMS 12-15
THE MIDDLE-MAN
T. M. REG. U. S. PAT. OFF. COPR. 1944 BY NEA SERVICE, INC.

. . . YOU CAN OBTAIN 60% TO 80% OF YOUR CARBIDE REQUIREMENTS

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Precision Boring Tools
Two types: (1) carbide tipped (with flat top or back rake) sizes 5/16" through 1½" dia. (2) solid carbide ½" through 1¼" dia.
General-Purpose Standard Carboloy Blanks
Style 1000
Style 2000
For emergency tooling, braze Carboloy blanks to your own shanks. More than 100 standard blanks available. For cutting steel, cast iron, non-ferrous metals and non-metallics. Sizes 1/16" to ½" thick.
Standard Turning, Boring, Facing Tools For Steel, Cast Iron, Etc. (You can grind to hundreds of special shapes. Wide range of sizes.)
Style 4
Style 12
Lathe and Grinder Centers
(Up to 50 times longer life than steel.)
Carbide tips only.
Finished tipped centers (with Morse, B & S, and Jarno Tapers).
Cut-Off Tools
For cutting off to hollow cores such as shell forgings, etc.
Tools for Roller Turners ("Box" Tools)
For W&S, Gisholt and Jones & Lamson lathes. Extra large tips and special shapes provide long period of tool life. Eleven standard sizes carried in stock.
Special-Purpose Standard Stock Carboloy Cemented Carbide Blanks
Scraper Blanks for 4 hand scraper sizes
Pointed Nose Blanks
Reamer Blanks 11 Standard
Grooving Tools
Style 10
Style 12
CARBOLOY
Carboloy Tool Catalog

Get maximum economy in your carbide tool and blank purchases. Order "catalog" standards and eliminate special drawings, special quotations and delivery delays. Carboloy Catalog GT-175R lists more than 300 standards designed to cover 60% to 80% of your machining requirements. Available at "mass production" prices in any quantity. Wide selection of styles, sizes and grades for cutting steel, cast iron, non-ferrous metals and non-metallics.

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West Coast . . .

OSGOOD MURDOCK

• In a region of plentiful hydro-electric power at nation's lowest rates, industries are rationed and Navy claims it is overcharged in the turbulent pool of public power politics.

SEATTLE—With two 25 ton electric furnaces installed and connected, the Hesse-Ersted steel plant at Portland has only been able to melt in one furnace averaging two heats a day mostly at night, recently. Reason: electric power shortage, and it has been necessary to buy ingots from another source to maintain schedules on the rolling mill.

Ohio Ferro-Alloys plant at Tacoma is understood to have also been limited in its operation in recent months because of electric power shortage.

The Navy is petitioning Seattle's City Light department for reduction in rates, claiming it is paying $19,000 more per month for electric power than it should for its four plants: Sand Point Air Station, Smith Cove Station, Associated Shipbuilders and Todd-Pacific Harbor Island yards. It is claimed by the Navy that if it were purchasing direct from Bonneville Power Administration instead of City Light of Seattle it would save $250,000 per year and that, furthermore, Federal funds have been granted to City Light upon occasion to increase its facilities.

Electric power shortage and high power rate to a Government agency in the Pacific Northwest at this time seems inconceivable at first glance, in view of recent substantial reduction in load for aluminum reduction plants on the Columbia River and at Spokane, for both aluminum and magnesium. Bonneville Power Administration now has installed 1,355,000 kw. This is currently being distributed as follows: 400,000 kw. to private power systems; 93,000 kw. to Seattle City Light; 61,000 kw. to the Tacoma municipal plant and 800,000 kw. to its other customers including industries, military establishments and smaller municipalities and public utility districts.

There is therefore no shortage of power but only a squeeze where private power companies are reluctant to purchase more from Bonneville than their power pool commitment. Where private industries who are large volume consumers of power are contract customers of private power companies or of municipal systems, they are therefore sometimes limited by the lags and legalistics of distribution rather than the unavailability of the power.

Now comes forward Senator Clarence Dill of the State of Washington at Spokane, advocating that the next Congress create a Columbia Valley Authority, similar to the Missouri Valley Authority which Senator James E. Murray of Montana and President Roosevelt have recently advocated and which, it is reported, "has a good chance for passing this winter."

"If Congress passes this Missouri Valley bill and our far Northwest congressmen fail to secure passage of a Columbia River Valley bill," declares Senator Dill, "we shall probably see $30,000,000 to $40,000,000 per year appropriated for post-war projects in the Missouri Valley while we plod along with $2,000,000 to $3,000,000 a year."

It is further reported hereabouts that Honorable Harold Ickes, Secretary of the Interior, favors a Missouri Valley Authority "subject to a cabinet officer." He is said to have stated that an MVA or a CVA as an independent agency like TVA would be "confusing and add an unwarranted burden on the President."

So fundamentally and essentially does the industrial progress and future of the Pacific Northwest depend upon the volume and cost of hydro-electric power and the policies of and relationship between the Federal, municipal, cooperative and private agencies involved in the generation and distribution of that power that a further understanding of local considerations and background factors is perhaps of interest.

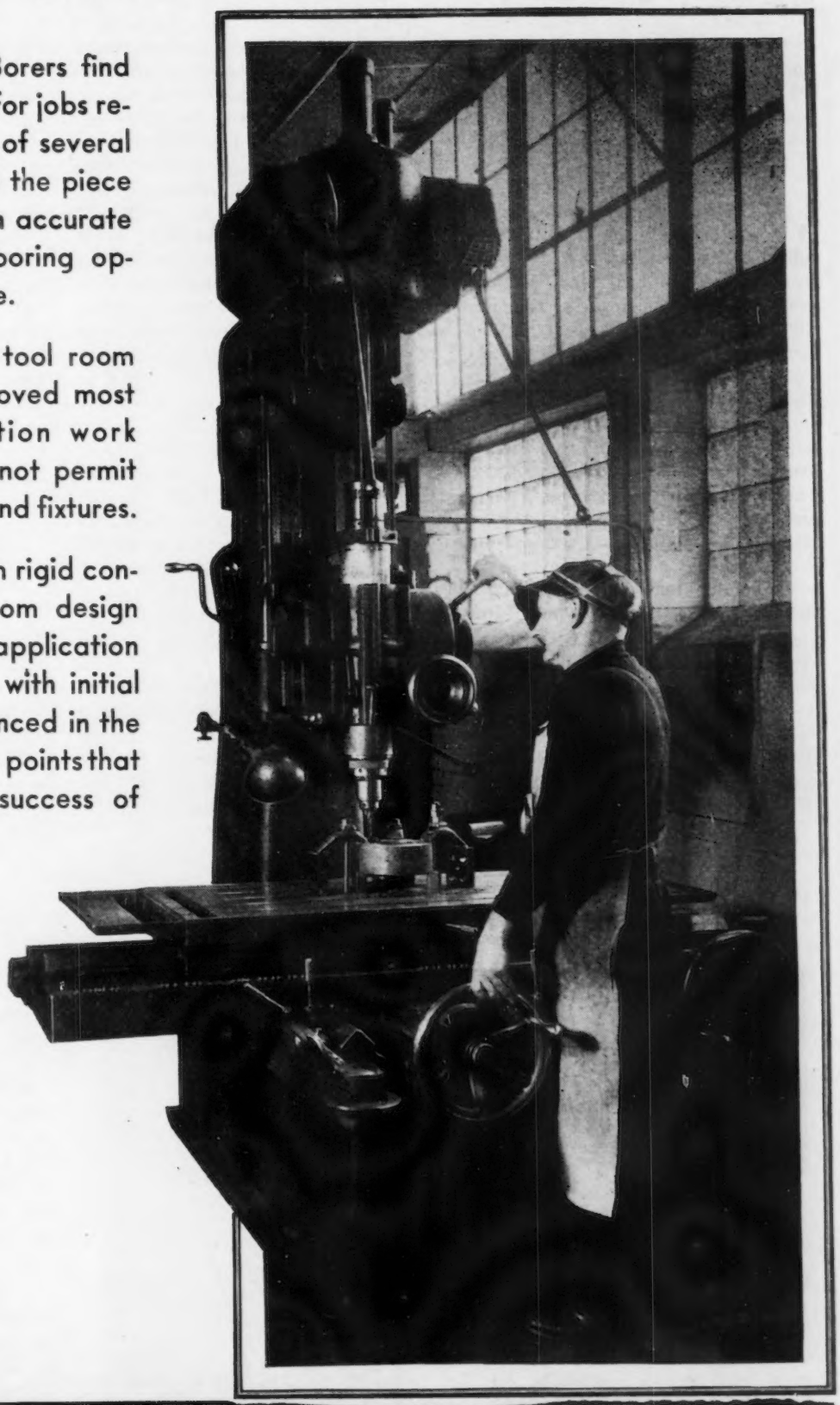
IN 1939, 11 private and municipal generating systems in the Pacific Northwest had generating capacity of approximately 1,000,000 kw. This has now been increased to approximately 2,500,000 kw., principally by the addition of the Bonneville-Coulee system. Bonneville is complete with installed capacity of 518,000 kw. and Coulee now has installed somewhat over 800,000 kw. but ultimately will generate 1,944,000 kw. More than half of the total electric energy available in Oregon and Washington is now supplied by the Federal plants on the Columbia River.

By statute the Bonneville Power Authority is limited to the generation and transmission of power. It must then sell to private power companies, municipal power plants, public utility districts or industrial users sufficiently large to take their power direct from the load centers and take advantage of the minimum rate of two mills per kilowatt hour at 100 per cent load factor.

In spite of the millions of dollars it has spent and the thousands of salaries and wages it continues to pay, and further, in spite of thousands of dollars poured into constructive research and development projects and a regional program of industrial and resources development under the able and resultful direction of Ivan Bloch, the Bonneville Power Administration is not popular in the Pacific Northwest. Private utility interests regard it as their big Government-backed competitor, determined to take them over or put them out of business. A considerable number of sizable municipal systems are likewise suspicious, fearing that the centralization of power control in a Federal agency directed from Washington will create dangerous political and economic as well as electric power domi-

For your precision jobs . . .

FOSDICK JIG BORER



• Users of Fosdick Jig Borers find them extremely accurate for jobs requiring precision spacing of several holes. On small work like the piece shown you can depend on accurate drilling—reaming—and boring operations with this machine.

Particularly adapted to tool room operation it has also proved most economical on production work where time or costs did not permit the use of expensive jigs and fixtures.

Accuracy that stems from rigid construction — versatility from design that permits wide range application —economy that begins with initial cost and is further evidenced in the low production cost—are points that make for the growing success of Fosdick Jig Borers.

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ARMY E NAVY

FOSDICK MACHINE TOOL COMPANY
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nance. Thousands of shareholders in and employees of private and municipal systems exert great influence. Average citizens without direct financial interest are suspicious of a starry-eyed Federal agency with undisguised social objectives engaging in and seeking control of a business, industrial and commercial function which is the very heart and soul of the entire region.

WITH all their data, with all their brilliance, despite their 1,300,000 installed kw., their 2,500,000 immediately planned, and ultimate proposed additional projects for from 2,000,000 to 4,000,000 more kw. of generating capacity, they sit on the sidelines, outside the door or beyond the pale. They meet with few Chamber of Commerce committees or native, independent planning groups, or bankers or business men or others who are genuinely working for the progress and advancement of the region. These representatives and administrators of a public agency built with public funds are pathetically viewed as outsiders, competitors, planners and schemers, determined to seize control of the mainspring and thereafter run the works to suit themselves or their poor relations. For this they largely have themselves to blame, perhaps, because in the early stages they loudly proclaimed the yardstick theory and played loud and strong on the strings of cooperative enterprise and social objectives, theories of socialism and evils of private capital and private utility operation. In Washington Secretary Ickes has been anything but an appeaser, and although from time to time he has avowed his interest in and friendship for the West, he has not convinced westerners that he means it, except as it might augment the power and influence of his own department and his ability to defy his favorite enemies, the private utilities and vested interests.

Apparently this same antipathy and lack of confidence does not now exist to the same extent in the area of the TVA, and the Bonneville Administration people believe that if they had authority to distribute power and sell it to ultimate consumers by taking over distribution, they could prove their value and fulfill their objectives. Their enemies and suspecters are just as firmly convinced that such an eventuality would, under present administrative circumstances through the present Department of the Interior, doom the entire Pacific Northwest to the feudal status of a satrapy.

David E. Lilienthal, director of the Tennessee Valley Authority, has been a public advocate of the restoration of economic equality among the regions of the United States. He has stated that "no region has a right to special privileges or immunity; the nation may not in equity deny any region and its people less than equality of opportunity." If the direction and administration of Federal power projects could be removed from the direction of the present Secretary of the Interior and the present Department of the Interior, to pass under a genuine Department of the West, or if an indigenous regional authority, sensitive to the real needs of the Pacific Northwest and disconnected from political and idealogical considerations at Washington, might be created with power to act, the difficult, disillusioning, discouraging and bitter power situation in the Pacific Northwest might be at least on the way toward solution. Presently, however, as the weeks and months pass, a more and more irresistible force of centralized Federal power administration is meeting an increasingly immovable body of popular suspicion, distrust and disfavor.

* * *

The Tacoma Narrows bridge, the one that blew down in a windstorm four years ago, will be rebuilt when materials and labor are available. The Pierce County (Tacoma) Toll Bridge Authority recovered $4,000,000 from insurance and salvaged $250,000 more. It has $3,200,000 in remaining assets, including anchorages, approaches and other piers. The loss at the time of its failure was estimated at $6,500,000.

* * *

Seattle will have a modern $500,000 ferry terminal as soon as the J. M. Colman Co. can secure materials and manpower to improve its recently purchased $125,000 waterfront property.

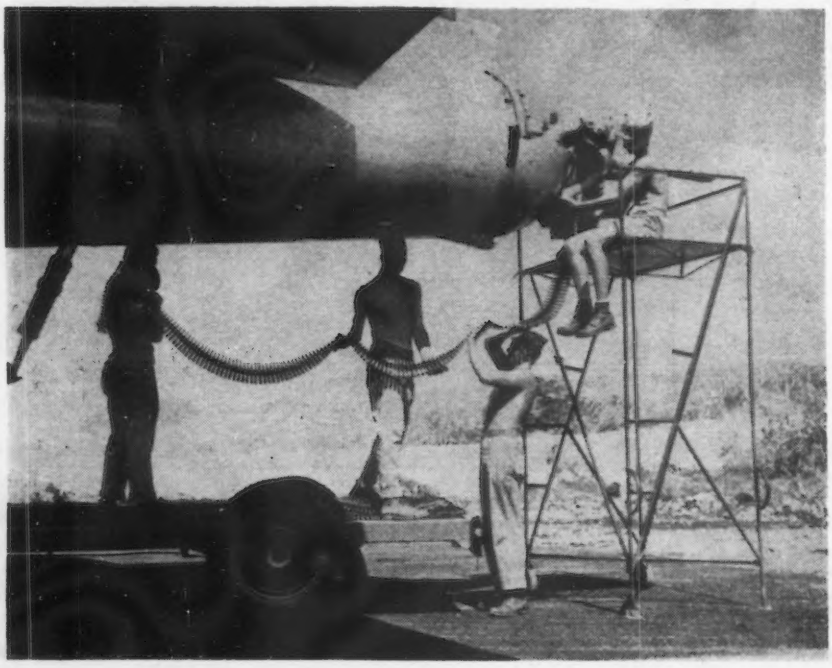
* * *

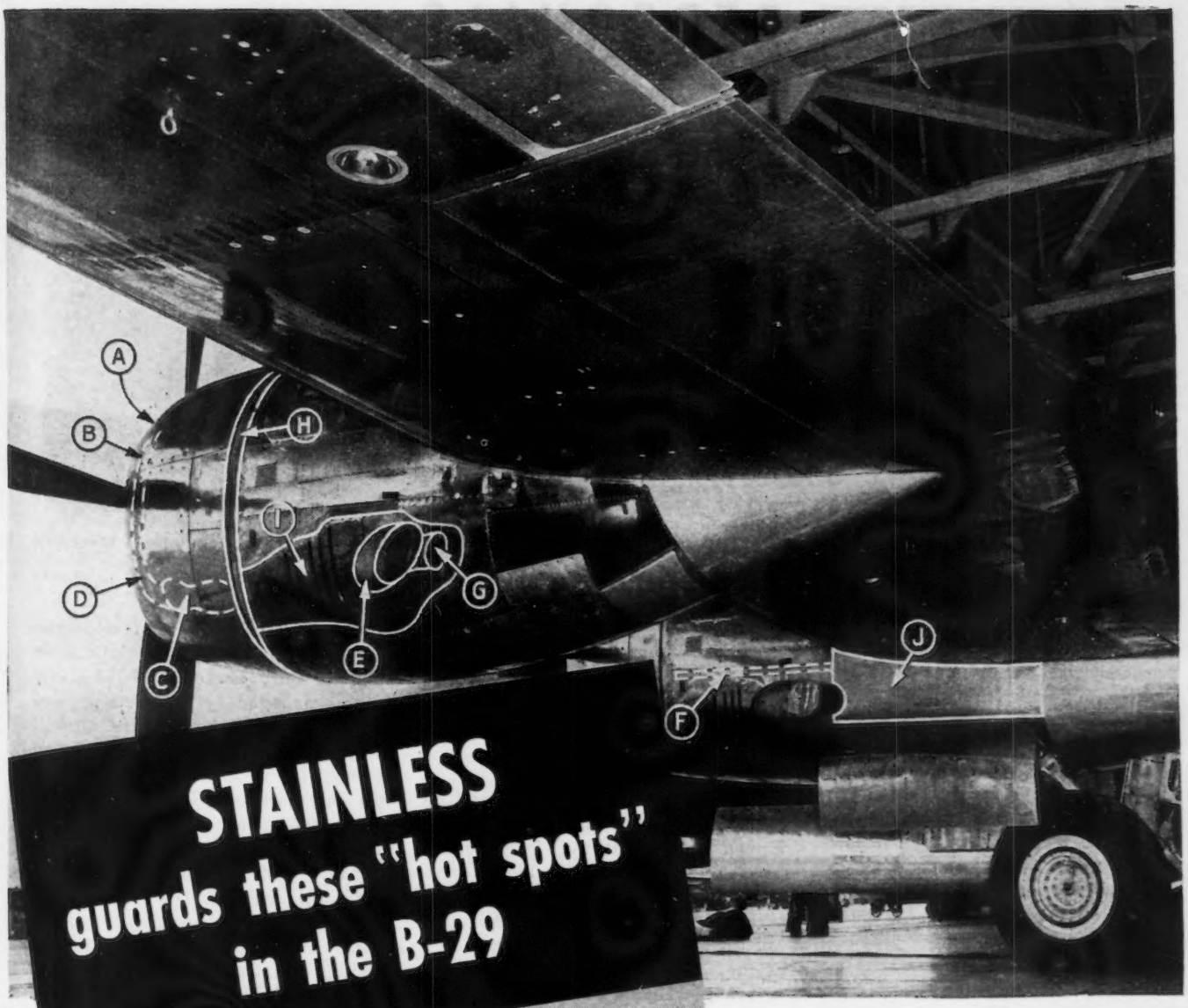
Everett Pacific Shipbuilding & Drydock Co. has recently completed its third floating drydock, 622 ft. long and 124 ft. wide, involving 7500 tons of steel. It lifts an 18,000 ton ship and was towed in three sections to the Moore Drydock Co. yard at Oakland, where it will be used.

* * *

Bethlehem Steel Co. has purchased outright the Pacific Coast Forge Co. at Seattle with its facilities for the manufacture of bolts, nuts, rivets and special headed and threaded products. The company was started in 1916 by three Seattle men, Albert J. O'Brien, John F. O'Brien and Carl L. Haven.

FILLING STINGER: *Much preparatory work is necessary at the B-29 bases in the Mariannas. Before each Tokyo raid long belts of .50 cal. ammunition feed the tail guns for protection from attacking fighters.*





STAINLESS guards these "hot spots" in the B-29

A Fwd. Collector Shroud
B Nose Ring
C Fwd. Tail Pipe Shroud
D Exhaust Collector
E Flight Hood
F Longeron
G Waste Gate Exhaust Pipe
H Inner Cowl
I Nacelle Shroud
J Slide Panel

Like all American warplanes, Boeing's super-battleship of the air is well equipped with stainless steel parts. This rustless metal is used wherever great strength and prolonged heat resistance are vital to efficiency and safety.

Some parts made of ARMCO Stainless Steels are indicated in this close-up view of the B-29. The four great housings of the Superfortresses' 2200-hp. engines embody stainless steel, selected for its strength and resistance to intense heat generated by the mighty power plants.

Other parts, like the collector systems, must "take it" too. In endless hours of combat flying, red-hot corrosive gases blast their way through exhaust collectors. And vibration puts stainless to a severe test. Yet this heat-resisting metal comes through unscathed in flight after flight.

You'll approve these other advantages of ARMCO Stainless Steels too: They form easily and can be fabricated by the fast spot-welding process. The strength-weight ratio is exceptionally high.

If you want qualities like these in your future products, consider using ARMCO Stainless. There is a grade for every requirement. For complete information just address The American Rolling Mill Company, 3561 Curtis Street, Middletown, Ohio.

EXPORT: THE ARMCO INTERNATIONAL CORPORATION

The American Rolling Mill Company

MADE OF ★ ARMCO ★ STAINLESS STEEL

PERSONALS

W. J. BEATTY, vice-president of foreign sales, ACF-Brill Motors Co.

• **W. J. Beatty** has been named vice-president of foreign sales, ACF-Brill Motors Co., Philadelphia. Mr. Beatty joined this company in 1909 and has been connected with foreign sales since 1914. In 1937 he was elected a vice-president of the J. G. Brill Co., Philadelphia. **L. H. Corlette** has been named vice-president of transit sales. Mr. Corlette was formerly district sales manager of the New York office, and has served during the war period as co-ordinator of postwar planning.

• **John C. Straub**, for the past 13 years associated with the Research Laboratories Division, General Motors Corp., Detroit, has been appointed research engineer of American Foundry Equipment Co., Mishawaka, Ind.

• **James V. Carmichael** has been named manager of the Bell Aircraft Corp., Georgia division, succeeding the late Carl A. Cover. Mr. Carmichael had been assistant plant manager. **Ernest J. Englebert**, a consultant at the plant, has been placed in charge of production at Marietta.

• **James E. McMullen** has been appointed controller and **Edward A. Montgomery** resident legal adviser of The Carborundum Co., Niagara Falls, N. Y. Mr. McMullen held a similar position with the Colorado Fuel & Iron Corp., Denver, during the past six years. Mr. Montgomery was formerly a member of the legal department of the Koppers Co., Pittsburgh.

• **Frank Gawan** has joined Joy & Cox, Denver, as sales engineer. He was formerly connected with the Denver Fire Clay Co.

• **Max W. Lightner** has been appointed assistant manager of the research and development division, Department of Research and Technology, Carnegie-Illinois Steel Corp., Pittsburgh. Mr. Lightner was formerly assistant to the general superintendent of Carnegie-Illinois' Homestead Steel Works. In 1942 he left the company to become vice-president of operations of the Heppenstall-Eddystone Corp. and was made director of research before returning to Carnegie-Illinois to assume his present duties.

• **A. B. Ordway**, whose association and service with Henry J. Kaiser antidates all other employees, has recently been appointed vice-president and general manager of the operating company for the Fontana steel mill.

• **S. M. Stoler**, formerly vice-president of Tate-Jones & Co., Leetsdale, Pa., has been appointed sales manager of the R-S Products Corp., Philadelphia.

• **O. B. Wilson** has been named New York industrial manager for the Brown Instrument Co., Philadelphia, precision industrial instrument division, Minneapolis-Honeywell Regulator Co. Previous to his appointment Mr. Wilson was industrial manager of the Chicago branch, and has been succeeded there by **J. A. Robinson.**

• **Howard W. Gilbert**, formerly manager of the inspection and test department of the National Malleable & Steel Castings Co., Cleveland, has been made engineering assistant to the president. Mr. Gilbert has been with the company since 1903. **Harold N. Whitmore** has become manager of the department, succeeding Mr. Gilbert. Prior to his present position Mr. Whitmore was chief inspector at the company's general office. **Archie J. Kashubeck** of the department of specialty development at Cleveland has been advanced to sales agent at the San Francisco office.

• **George E. Horney** has been elected to the board of directors and appointed assistant to the president, Pittsburgh Screw & Bolt Corp., Pittsburgh. Mr. Horney, formerly resident vice-president of the Gary Screw and Bolt Division, will be located in Pittsburgh. **Gerald J. Garvey** has been appointed general manager of the Gary Screw and Bolt Division, with offices in Chicago.

REMO REGE, master mechanic, Wright Aeronautical Corp.

• **Remo Rege** has been appointed master mechanic of the Wright Aeronautical Corp., Paterson, N. J. Formerly manager of production engineering, Mr. Rege has been with Wright for 24 years and has come up through the ranks. **Edwin H. Prange** has succeeded Mr. Rege as manager of production engineering and **Francis A. Paquin** has been made assistant manager. Mr. Prange started as a tool maker with Curtiss Aeroplane & Motor Co. in Buffalo 29 years ago and transferred to Wright Aero. Corp. following the Curtiss-Wright merger. **Lester Brown** and **Joseph De Voe** have been promoted to chief tool designer and assistant chief tool designer, respectively.

• **N. E. Dawson**, vice-president in charge of the Los Angeles activities of the Soulé Steel Co., San Francisco, has retired from active duty, after 28 years of service. He will continue as a vice-president in an advisory and consulting capacity. **E. B. McClure** has been elected a vice-president to succeed Mr. Dawson.

• **Theodore H. Sanderson** has been appointed superintendent of the Armor Plate Division, Gary works, Carnegie-Illinois Steel Corp., Pittsburgh, succeeding the late E. N. Yost. Mr. Sanderson began his service in the corporation in 1933, and prior to his recent appointment was assistant superintendent of quality control at the armor plate plant.

• **Lewis W. Douglas**, president Mutual Life Insurance Co. of New York, has been elected a member of the board of directors, General Motors Corp., Detroit.

BERT S. INCH, general sales marager, Permanente Metals Corp.

• **Bert S. Inch**, for ten years with Henry J. Kaiser and the Six Companies, and previously executive assistant to Edgar F. Kaiser in shipbuilding at Portland, Ore., has been appointed general sales manager of the Permanente Metals Corp. at Permanente, Calif.

• **Herbert F. Weaver** has been appointed manager of forging sales for Bethlehem Steel Co., Bethlehem, Pa. He has been with Bethlehem Steel since 1901, and sales agent of press and hammer forgings since 1922.

• **William T. Kelly, Jr.**, general purchasing agent of the American Brake Shoe Co., New York, has been appointed executive vice-president of the Kellogg division of that company at Rochester, N. Y. He is chairman of the OPA Industry Advisory Committee for Iron and Steel Scrap.

• **George B. Doane, Jr.** has become associated with New York Commodities Corp., New York. Mr. Doane, formerly of Perry Buxton Doane Co., Boston, was until recently a scrap buyer for Bethlehem Steel Co. For more than two years he had also served with WPB.

• **Newton R. Collins**, manager of the Truck Assembly Division, White Motor Co., Cleveland, has been appointed director of the Material Control Division.

• **W. R. Duda**, has been appointed vice-president in charge of engineering; **W. L. Berghoefer**, vice-president in charge of casting sales, and **B. P. Hammond**, manager of casting sales, Pittsburgh district, of the Continental Foundry & Machine Co., East Chicago, Ind.

• **William de Back**, former vice-president and general manager of Chisholm-Ryder Co., Niagara Falls, N. Y., has been named vice-president and a member of the executive committee of Food Machinery Corp., Hoopeston, Ill.

JACK L. ASHBY, general sales manager, Iron & Steel Division, Kaiser Co., Inc.

• **Jack L. Ashby**, who has been in charge of the service and sales organization of the Iron & Steel Division, Kaiser Co., Inc., Richmond, Calif., since its inception in February 1943, has been made general sales manager with headquarters at Oakland, Calif. **Norman H. Balaam**, formerly with the Kaiser organization at Oakland, has been named district sales manager for southern California and **Fred E. Lord**, formerly with the Kaiser shipbuilding division has been made district sales manager for the Pacific Northwest.

...OBITUARY...

• **Sven R. Bergman**, for 42 years an electrical engineer at the General Electric Co.'s Lynn, Mass., works, and co-worker with the late Dr. Charles Steinmetz, died at Nahant, Mass., November 25. Mr. Bergman, who several years ago developed the standard direct current generator for arc welding, was 67 years old. Since 1919 he had been a consulting engineer at that plant.

• **Carl A. Cover**, 51, manager of the Georgia division, Bell Aircraft Corp., Buffalo, died November 27 at Dayton in a plane crash. Also killed in the same accident was **Max Stupar**, 59, director of industrial planning at Bell's Buffalo plant.

• **Walter F. Marks**, 73, manager of the Milwaukee office of the National Lead Co., New York, until his retirement several years ago, died November 24.

• **Edward H. Myers**, 67, former assistant superintendent of Cutler-Hammer, Inc., Milwaukee, died November 23.

• **Dr. T. Swinden**, director of research of the United Steel Companies, Ltd., Sheffield, England, died suddenly, October 27. He was 59 years old. Dr. Swinden, who was a director of the British Magnesite Corp., Ltd.; Distington, Hematite Iron Co., and Samuel Fox & Co., Ltd., had won international recognition as a metallurgist. He was made a Doctor of Metallurgy in 1913. For his meritorious services to the industry and his notable contributions to technical literature, Dr. Swinden was awarded the Bessemer Gold Medal of the Iron and Steel Institute in 1941, the highest honor the Institute can bestow.

• **Alfred S. Gunn, Sr.**, general manager of the Bethlehem Steel Co.'s shipbuilding division on the Pacific Coast, died November 30. He had headed Bethlehem's ship repairing and shipbuilding activities on the West Coast for the past 17 years.

• **Emile Darte**, 66, vice-president and general manager of the Electro-Metallurgical Co. of Canada, Ltd., a Union Carbon & Carbide Co. unit, died on November 26.

• **Roland G. Justus**, 53, manager of industrial sales, Westinghouse Air Brake Co., Wilmerding, Pa., died November 30.

• **Walter E. Meub**, vice-president in charge of finances for Youngstown Sheet & Tube Co., Youngstown, Ohio, with which he had been associated since 1909, died November 28.

• **Frederick A. Barnes**, consulting engineer, formerly works manager of Bailey Meter Co., Cleveland, died November 29.

• **George E. Bechtel**, 61, vice-president of The Trundle Engineering Co., Cleveland, since 1938, died suddenly December 4. Mr. Bechtel had been with the company since 1928.

• **Hugo Voigt**, former Chicago manager for the Geuder, Paeschke & Frey Co., Milwaukee, died November 25, at the age of 84.

Fatigue Cracks . . . BY A. H. DIX

Scoff from Schenectady

• • • A pair of mystifying initials is contributed by Miss Alice V. Neil, librarian of GE's research laboratory at Schenectady. Miss Neil writes:

> I am surprised that the b.d. has not as yet unearthed the very choice bit of publicity for the f.f.j. which appears in the December issue of the Reader's Digest.

As we blurbed last week, the orchid is in William L. White's "Report on Russia," who relates that the director of a Soviet automotive plant said with pride that he is a member of the Society of Automotive Engineers and a reader of THE IRON AGE.

But we do not know what "b.d." stands for. "Board of directors" does not apply, nor does "blood donor." Does Miss Neil mean "braying department"?

Baltimore Oriole Bronx-Chirps Again

• • • We receive about half a dozen anonymous letters each week, most of them from modest people who want someone to be aware of the fact that they have solved the puzzles but who shrink from letting the world know of their genius.

A different type of anonym is "McC.," who has been writing us from Baltimore off and on now for the past ten years. He never solves any puzzles but contents himself with mildly acid observations on our attempts to blow your favorite family journal's bugle with no apparent cheek puffing.

His latest letter calls attention to the *Reader's Digest* reference, and as if ashamed of performing a kind deed, he manages to administer, in his last seven words, the inevitable tablespoonful of vinegar. His letter ends with:

> This is a priceless piece of advertising for your publication, whether the subscriber can read English or not.

Novocaine Words

• • • In time we hope to compile a list of words whose meaning is cloudy to us no matter how often we hear them or look them up. As a starter we will mention *implement* (the verb), *invidious*, and *factual*. We find each of them as hard to grasp as a jelly fish, and whenever we encounter them the effect is numbing.

Initial Plague

• • • The same thing applies to the use of initials. We think that if the newspapers made a survey they would find that even the more literate of their readers would not score 50 per cent in interpreting the initials of the better known Washington bureaus, let alone the lesser known. You might try your hand on these examples: NLRB, ODT, FCC, FEA, UNRRA, FHA, APC, OCD, WSA, and SWPC. We ourself are not even sure what CIO stands for. We think it means "Congress of Industrial Organizations," but would not give more than 3 to 1 on it.

Even in these days of tight paper, it is a kindness to the reader to spell out at least the first reference to an organization in a news item.

Aptronym

• • • L. F. R. Bellows grew up to make, of all things, air power devices. He now heads the Bellows Co., of Akron, Ohio.

Exciting Trip Through Postal Guide

> . . . May we say Stet (Mo.) to Tranquillity (N. J.) or Bustleton (Pa.)! But do not overlook Busy (Ky.) or Boom (Tenn.) or Competition (Ga.) . . .
>
> There's quite a Story (Ark.) in place names. If you don't believe us just Mix (La.), Wateree (S. C.), Gravelly (Ark.) and Cement (Okla.) and you get Concrete (N. D.).
>
> Just Aline (Okla.) from
> *G. Harris (Lukens Steel) Danzberger*

Ever-Watchful Brains Department

• • • We are always grateful to the editor who translates a foreign phrase for us, who tells us how to pronounce an unusual name, and who otherwise sees to it that our enjoyment of a particular article or piece is not marred by the assumption of a knowledge we may not possess.

Your favorite family journal never makes this error. It takes nothing for granted. Look, for example, at the article on page 52 of the Nov. 30 issue dealing with the reclamation of defective castings. How were the castings made? They were cast. So you have the headline, "*Salvaging of Large Cast Iron Castings.*"

This is a practically foolproof head, but we would like to see "ferrous" worked in. "*Large cast iron ferrous castings*" would be perfect.

Sorority to Surplus

• • • Having a weakness for alliteratives, we are glad that the mode of action developed by Lt. Col. A. E. R. Peterka for the disposal of surpluses is popularly known as the "Peterka Plan" (page 100, Nov. 30 issue). The name, pronounced "peh-*turk'*-eh," is an unusually pleasant exercise for the vocal organs; and as the plan is sound, much is heard of it.

The name's oral excellence led to its adoption for another use. Back in the early '20s, when the Colonel was prominent in fraternity circles at Case School of Applied Science, Cleveland, he was asked to advise in the founding of a sorority chapter at a nearby girls' college.

Tempus fugits to 1943. Scene: a social event in the Sixth City. The Colonel is introduced to a student at the girls' college, who starts visibly at the mention of the name Peterka. "Why," she says, "that's our sorority password!"

The Colonel is already generously initialed but it would have been nice if he had one more given name, one beginning with O. Considering that he is an Army Air Force colonel, A. E. R. O. Peterka would be an aptronymic grand slam.

Puzzles

We reported that no one had been able to express 41 with five 3s, but Eric (Kaydon Engineering) Zachau has found a way, and this is it: $\frac{3 \times 3 + 3 + .3}{.3}$

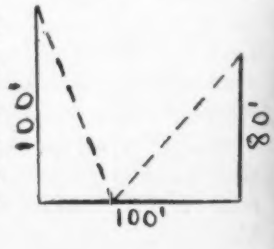
Martin Wm. (Westinghouse, Bloomfield, N. J.) Offinger says that R. H. (General Electric) Rogers' answer to the Nov. 23 ball of yarn problem is wrong. Two women divided an 8-in. ball of yarn by the process of the smart one reeling off her share until the ball was 4-in. in dia. and giving the little ball to the dumb one. GE says the smart woman got 73 per cent of the yarn. Westinghouse says 87½ per cent. We like to see the big boys fight and hope no outsider butts in.

Mr. Offinger also reports that Dr. Chuk Ching Ma of the Westinghouse research laboratory says the highest number expressible with five 3s is $\frac{333,}{3\text{-}3}$ which is infinity.

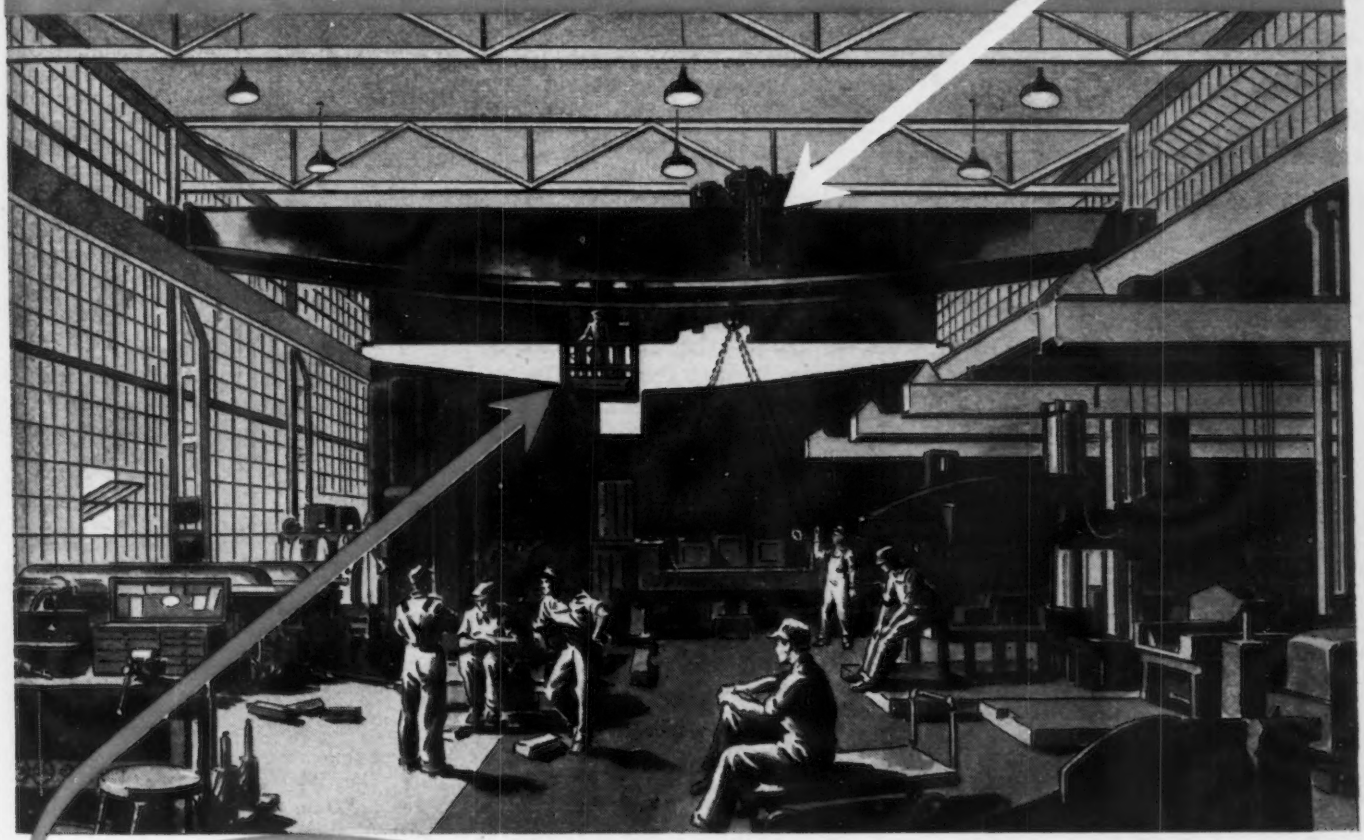
Among other answers are 3^{3333} (J. M. Paddon), $3^{3^{3^{3}}}$ (J. Malvern Benjamin), and the five factorial 3s in ascending order (A. C. Wilcox). We will take Mr. Wilcox' word for it that this last equals 3 followed by 1008 zeros.

E. R. Casey, Supt., the Union Pacific Store Dept., Evanston, Wyo., sends this in:

A ladder is set between two walls, one 80 ft. high, the other 100 ft. The walls are 100 ft. apart. What length ladder will set in one place on the ground, tip over so that the tip touches the top of one wall, and tip over the other way and touch the top of the other wall? And how far from each wall will the base of the ladder be set?



WAITING FOR THIS CRANE LOSES LOTS OF MAN HOURS



AN EXTRA Northern CRANE Would Save Them

Maybe they wait only a few minutes—but if they do it many times a day, plenty of man hours are lost—and you pay for them.

Moreover, the whole production schedule is slowed—time is lost everywhere—costing money and impeding your part of the war effort.

An extra Northern Crane on the runway will save all these countless minutes now being lost. Also, if you have an extra crane you need not fear breakdown—it won't tie up your shop.

Investigate the time saving possibilities of an extra crane.

Northern Cranes are fast, powerful, strong, have fine control. They are the fine machine tools of material handling.

Northern ENGINEERING WORKS

General Office: 2615 Atwater St., DETROIT 7, MICH.

NORTHERN CRANE & HOIST WORKS Limited • WINDSOR, CANADA

OFFICES IN PRINCIPAL CITIES

Dear Editor:

INDUSTRIAL JAPAN

Sir:

The industrial map of Japan in your April 30, 1942 issue, was used as the basis for the enclosed poster, which will go up on our bulletin board as soon as we complete our Bond Drive.

HENRY M. EICHNER
c/o Labor-Management Committee,
Murray Corp. of America,
7700 Russell St.,
Detroit 11

Sir:

Kindly send us a copy of the map of industrial Japan as described in your Sept. 14 issue.

PAUL F. FLYNN
Heppenstall Co.,
Howard Ave.,
Bridgeport 5

● The map originally appeared in three colors, but as the plates had been remelted, we could print it in only one color. However, it looks very nice, and if you want one, send us 25c. to pay for mailing costs. —Ed.

WASHED SKIMMINGS

Sir:

Please quote us prices on washed skimmings in yellow brass, bronzes, nickel, and aluminum.

WM. D. PRICE
Dreisbach Engineering Corp.,
55 Warburton Ave.,
Yonkers, N. Y.

● Skimmings don't come under the OPA price regulations. We suggest that you send samples of your skimmings to your scrap dealer for analysis and quotation.—Ed.

SILVER ALLOY BRAZING

Sir:

In describing the technique of the silver alloy brazing method (Sept. 23, 1943 issue, page 38), you say that new Selas type burners were used. Where may they be procured and what accessories are needed with them?

R. G. HOWARD,
Process Engineering Dept.
Bausch & Lomb Optical Co.,
Rochester

● The Selas type burners are manufactured and sold by the Selas Co., Erie and D Sts., Philadelphia.

STEEL COMPOSITE PRICE

Sir:

In our industrial price work we use the composite price on finished steel published in THE IRON AGE under Composite Prices. We note revisions have been made in the Nov. 16, 1944 issue, in the one week ago, one month ago and one year ago prices from those published in the preceding issue. Will you please explain the reason for the revision?

JESSE M. CUTTS,
Industrial Prices Div.
U. S. Department of Labor,
Washington 25

● "The Iron Age" composite index of finished steel prices for the years 1941, '42 and '43 is based on shipments for the year involved. The current index is to be based on quarterly shipments. In calculating the composite price, the percentage of each component to the total tonnage of ten selected steel items sold each quarter is multiplied by the prevailing price. The final sum is the finished steel price index.—Ed.

SURPLUS TOOL STEELS

Sir:

As there is considerable quantity of tool steel available now in surplus war property, please send *The Iron Age Directory of Tool Steels.* We could make good use of this information in segregating our materials as to brand name and manufacturer.

CHARLES G. ALEXANDER,
Surplus War Property Div.
Loan Agency of the
Reconstruction Finance Corp.,
407 North Eighth St.,
St. Louis 1

● The directory is available at $1 per copy or 50c. in quantities of 5 or more.—Ed.

TEMPLATE FOLLOWER

Sir:

We understand that an article on electronics was recently contributed by W. D. Cockrell, and describes the use of the electronic tube for following paper templates for flame cutting purposes. We should like to have more information as to the equipment, and would be glad if you could put us in touch with Mr. Cockrell or the manufacturer.

A. THROP,
Technical Director
Edward Pryor & Son, Ltd.,
Broom St.,
Sheffield 10, England

● The article "Electronics in Review" in the July 20 issue mentions a phototube to view a drawing in ink or crayon on white paper that replaces the expensive metal or fiberboard templates previously required. Paper templates can be reproduced photographically as many times as necessary. We are asking W. D. Cockrell, Industrial Engineering Div., General Electric Co., Schenectady, N. Y., to furnish you with additional information.—Ed.

DIE MATERIALS

Sir:

Kindly furnish us with a reprint of the article, "New Developments in Die Materials," published in your Oct. 12 issue.

W. KAUDERS
Hydropress, Inc.,
570 Lexington Ave.,
New York

● Mailed.—Ed.

QUENCHING OIL

Sir:

I would appreciate tear sheets of your articles "What Quenching Oil Not To Use," by G. W. Pressell, issue of Nov. 9, and "What Quenching Oil To Use" by W. G. Forbes, issue of Aug. 3.

F. R. MORRALL,
Technical Service & Develop. Div.
American Cyanamid Co.,
Stamford

CHROMIUM SOLUTION

Sir:

We understand there is a new chromium solution on the market used for decorative purposes that operates with less current and a lower temperature.

CLAIR PARKS
Canton Cadmium Plating Shop,
1538 Vine Ave., S.W., Canton 6

● Many chromium plating solutions are available but the sulphate bath is the only one generally used, in spite of the fact that from time to time claims appear for new solutions with advantages such as less current, lower temperature, etc.—Ed.

FURNACE ROOFS

Sir:

The following passage from page 59 of the Oct. 12 issue is of great interest: "One major electric furnace operator has found that Sillimanite roofs outlast conventional silica roofs three to one. The Sillimanite roof also gives more warning prior to failure than the silica roof." We should like more information.

FRANK KIPER
Ohio Steel Foundry Co.,
Lima, Ohio

● Data may be secured from Charles Taylor Sons Co., 715 Burns St., Cincinnati 14. Service installation data will appear in the forthcoming report of the 1944 AIME Electric Furnace meeting which soon will be published by the American Institute of Mining Engineers, 29 West 39th St., N. Y.—Ed.

PRECISION CASTING

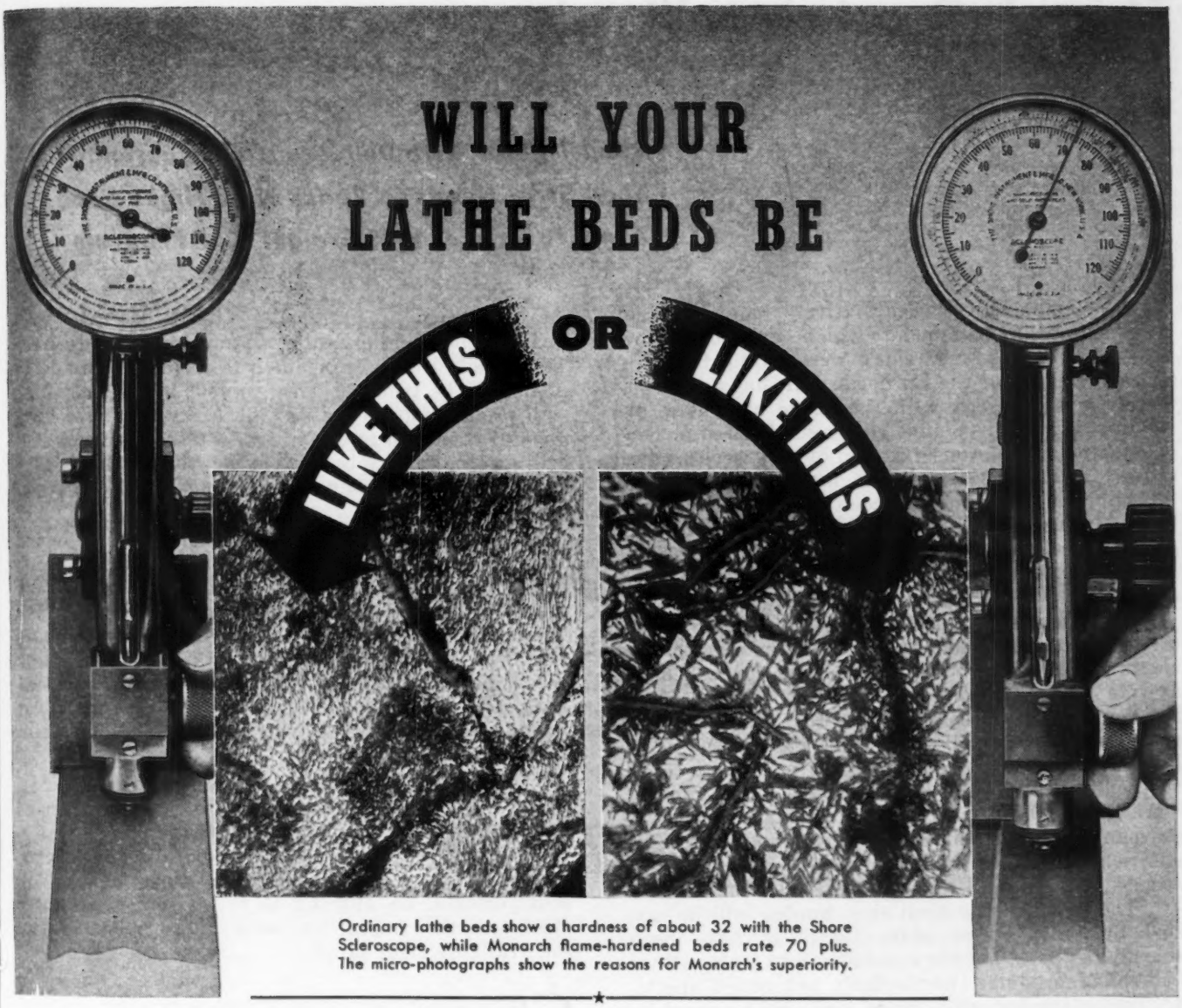
Sir:

I have just read the very fine Nov. 9 article by J. Albin, "Equipment and Material for Precision Casting." Are reprints available?

RICHARD A. WOLFF, Chief,
Industrial Processes Branch
War Production Board,
Office of Production Research
and Development,
Washington, D. C.

● No, but we are glad to send you a clipping. See also the second part of this article in issue of Nov. 16.—Ed.

WILL YOUR LATHE BEDS BE LIKE THIS OR LIKE THIS



Ordinary lathe beds show a hardness of about 32 with the Shore Scleroscope, while Monarch flame-hardened beds rate 70 plus. The micro-photographs show the reasons for Monarch's superiority.

● Users of the more than 18,000 Monarch lathes with flame-hardened bedways have proved the value of this Monarch process. They've watched these surfaces quickly take on a gleaming, lustrous polish. They've found that after years of proper use, Monarch bedways remain smooth, free of scores, pits and scratches, and maintain the lathe's original high accuracy. Depth of hardening is shown in the cross section below, which is approximately one-half actual size.

Check bedway hardness when you're buying new lathes. It's one important key to long life and usefulness. Ask a Monarch representative to show you in customers' plants how these bedways have stood up even under grueling wartime service. And let him demonstrate the many other Monarch features that will cut your postwar turning costs.

THE MONARCH MACHINE TOOL COMPANY
SIDNEY, OHIO

BRANCH OFFICES

CHICAGO 6, ILLINOIS
622 W. Washington Blvd.
Phone Haymarket 3534

DETROIT 2, MICHIGAN
801 Fisher Building
Phone: Trinity 1-0426

CLEVELAND 6, OHIO
Room 209 Upper Carnegie Bldg.
10465 Carnegie Avenue
Phone: Garfield 2590

PITTSBURGH 22, PA.
512 Empire Building
Liberty Ave. and Stanwix St.
Phone: Atlantic 6428

NEWARK 2, N. J.
635 Industrial Office Bldg.
Phone: Mitchell 2-1770

Ask for Bulletin No. 194 which explains Monarch Flame-Hardening process in detail and shows its advantages.

Monarch Saves Time

This Industrial Week . .

- **Steel Tighter with Deliveries More Extended**
- **Shell Steel Needs to Reach New Highs Soon**
- **Army to Cancel 1945 Freight Car Program**

ANY semblance of the relatively balanced steel supply and demand which existed a few months ago when there were strong hopes of an early ending of the European war, has been completely washed away with the surge of orders, directives and inquiries involving rehabilitated or new war material programs. On top of last week's news comes further indication this week that despite a lessening in plate output, sheet demand is stronger, bar deliveries are more extended and tentative programs for shell steel needs are such as to cause a tightness in steel demand until Germany is definitely defeated.

Although new war requirements involve items other than shell steel, this product has taken the center of the stage because its production will have a wide circle of influence on the output of other steel products. It now appears that the output of shell steel covering all sizes which has jumped nearly 90,000 tons since September, is scheduled to be further increased over present levels to the tune of more than 200,000 tons a month by March 1945. If Germany is not defeated by that time, even greater additional tonnages are expected to be sought by the Armed Forces.

The brunt of the shell steel burden will be carried by mills whose plate schedules have been sharply cut back, but the squeeze will be tight. Other flat rolled products, particularly hot rolled sheets, are competing for space made available by the drop in plate tonnage on continuous mills. Further complicating the flat rolled picture, is the increasing demand for plate discs used in the production of mortar shells. This tonnage is relatively small compared to total plate output, but adds further fuel on the fire of tight deliveries and product scheduling.

CARRYOVERS are mounting as a result of the shell steel program, especially on regular and quality steel bars. Producers view the situation as acute. Directives have been necessary to secure scheduling of structurals for many important projects and currently there is no sign that the situation will improve.

Although warehouses have reflected a large appetite in taking advantage of a recent order allowing them to place orders for 25 per cent of the base period or third quarter sales in addition to normal replacements, present indications are that they may go hungry because of the tight situation.

Galvanized sheet delivery schedules, now greatly over-extended, are being stressed further by Army requirements for corrugated culvert pipe. Some of this material is being used in Europe for draining roads and air fields and also for building temporary structures. Deliveries are so far extended on galvanized sheets that promises appear meaningless.

The railroad freight building market is active again, despite the expected cancellation this week by the Army of practically all of its 1945 railroad car building program. Army freight orders for about 26,000 units, scheduled to have been made in 1945, will be trimmed down to 4800 and all of these will probably go to India. The Army is said to have several thousand finished cars in this country which will go into service before any new orders have been placed or before any outstanding orders are authorized.

On the domestic car market, total orders placed from Oct. 1 to Dec. 1, approximate 40,000 units. Since Dec. 1 an additional 10,000 cars have been placed, but these must await approval by the WPB Transportation Equipment Branch before construction will begin. Outstanding orders in this most recent batch include 4000 for the New York Central Railroad. The Chicago and Northwestern Railroad has placed various types of cars totaling 2500 units with several car builders.

The heavy war toll on railroad equipment has caused some car builders to look for a postwar market somewhere in the neighborhood of 100,000 cars a year for at least five years. Car building programs for early next year will, like other essential civilian requirements, be affected to the extent that shell steel and other urgent war needs make inroads upon the available steel supply.

COINCIDENT with the increased demand for war steel, the promise of a longer war in Europe and the rise in the steel ingot rate, scrap prices are hitting the ceiling in practically every district this week. THE IRON AGE steel scrap composite price is up 50c. a gross ton this week to $19.17 a gross ton.

The national steel ingot operating rate has increased half a point to 96 per cent of capacity. Increases in output have occurred in two districts: Valleys, up one to 94 per cent and Buffalo, up 12 to 102. Cleveland production has declined four and a half points to 94 per cent while in Cincinnati, steel ingot operations dropped 10 points to 96 per cent. In the Eastern District, output has decreased eight points to 90 per cent. Unchanged from last week are Pittsburgh at 92; Chicago at 101; Philadelphia at 96; Wheeling at 91.5; Birmingham at 99; Detroit at 100; the Western District at 92.5, and St. Louis at 94.5.

A study of the Chinese steel situation indicates that there is no chance of China regaining and utilizing what was once the major part of its small iron and steel industry until Japan is defeated and Manchuria wrested from her control. At the present time more than 85 per cent of China's iron ore reserves are in regions either occupied, invaded or penetrated by the Japanese. China's iron and steel capacity exclusive of Manchuria is believed to be about 140,000 tons of pig iron annually and about 10,000 net tons of steel annually.

• **POSTWAR CONSTRUCTION**—Private industrial construction in 1945 will exceed public industrial construction for the first time since 1940, it was predicted at a meeting of the Producers' Council in New York City recently. Basing the prediction on postwar estimates of industrial construction prepared by the Market Analysis Committee of the Council, Charles E. Young, economic research supervisor of the Westinghouse Electric & Mfg. Co., holds that for 1945 there is expected a decline from 1944 of about 13 per cent in total industrial construction, from an estimated 845 million dollars to a projected 735 million. This results from a year-to-year decline of 59 per cent in publicly-financed industrial construction, largely offset by a thumping 171 per cent gain in new, privately-owned plants, he believes. Mr. Young doubted that the war plants the government will offer for sale will have a serious affect on private industrial construction, because of their size and special applications such as ordnance, shipways and aircraft programs.

• **PEARL HARBOR's ANSWER**—The American Iron & Steel Institute says that in the first three years of the war, from Dec. 8, 1941, through Dec. 7, 1944, the steel plants of the United States produced a record-breaking total of more than 263,000,000 tons of steel ingots and castings. That total is nearly 80 per cent more than production in the three best years of the first World War, and exceeds by nearly 55 per cent the maximum tonnage produced in any three-year period of peacetime.

• **FERROALLOY PRICES**—There are to be no changes in the prices of the ferroalloys during the first quarter of 1945, according to a prominent producer of these alloying agents, with the possible exception of ferrotungsten whose price will remain constant at least during January. Prices of the ferroalloys are controlled by OPA Maximum Price Regulations under which there can be no increases without the presentation of data for the approval of that agency. This is not contemplated by ferroalloy producers in the immediate future.

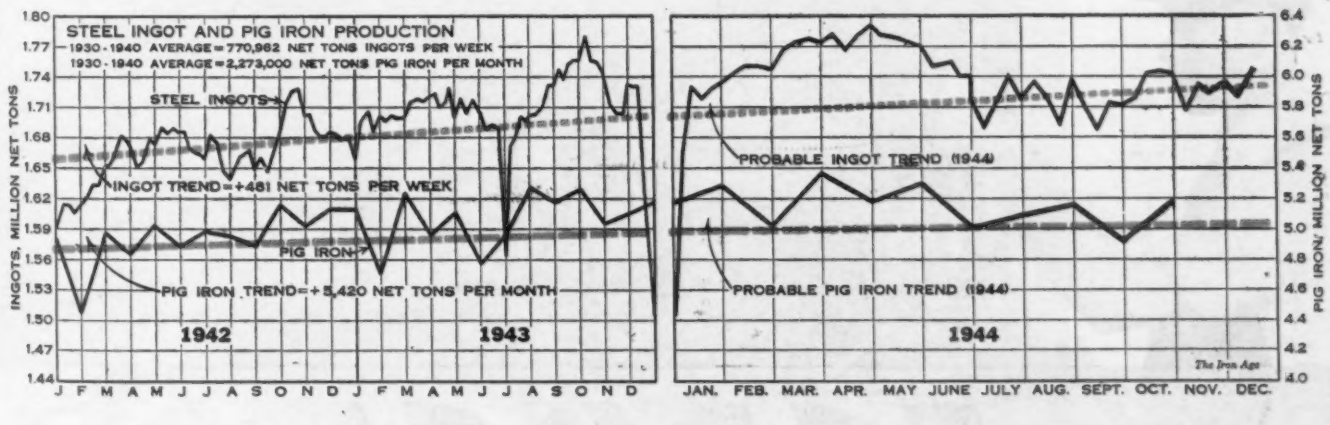
• **FORMS EXPORT POOL**—Norman F. Clayborne, president of Clayborne Distributors, 209 S. LaSalle Street, Chicago, has announced plans to organize a selling pool among small manufacturers who wish to participate in foreign trade. More of this type of organiztion is expected in view of small companies lacking support staffs and sufficient capital to extend large credits.

• **BULLISH SCRAP MARKET**—Those involved in buying, selling and reporting scrap are usually either very bearish or very bullish. They also are flexible and readily prepared to go to sleep one night with a dull low market and wake up to a strong scrap swing. Everyone adjusts himself to these sudden changes. Now prices in many cases are up to ceiling after a two or three months' toboggan ride. Scarcity is the watchword now where a month ago "there was plenty." The smashing of optimistic hopes of an early ending of the war had something to do with the current tightness and higher prices. But were good war news to come in the next few months, the market would probably react and a downward normal market swing take place.

• **STEEL EMPLOYMENT DOWN**—The steel industry employed in October an average of 564,300 persons, compared with an average of 565,200 workers in September. In October 1943, the total number of employees was 614,940, according to the American Iron & Steel Institute. The October payroll was $141,656,700, compared with the September payroll of $142,209,500. In October 1943, the payroll was $144,936,875. Wage-earning employees received an average of 118.3c. per hr. in October, compared with 121.0c. per hr. in September and 115.8c. in October 1943. Wage earners worked an average of 46.3 hr. in October, compared with an average of 47.2 hr. per week in September and 44.6 hr. in October 1943.

• **BIG STEEL SHIPMENTS**—Shipments of finished steel products by subsidiary companies of U. S. Steel Corp. for the first eleven months of 1944 were the highest on record. Shipments for November, 1944 were 1,743,753 net tons. compared with 1,774,969 net tons in October, a decrease of 31,216 net tons, and with 1,660,594 net tons in November 1943, an increase of 83,159 net tons. For the year 1944 to date, shipments were 19,383,188 net tons, compared with 18,525,206 net tons in the comparable period of 1943, an increase of 857,982 net tons.

• **CAR OWNERS SHIFT** — Passenger cars in use throughout the United States have declined 13.18 per cent in the past three years, a study by R. L. Polk & Co. indicates. Out of 27,700,011 registrations in passenger cars in 1941, said the statistical agency, 24,048,711 are still operating. The effect of the shifting of populations through the war is aptly indicated in the Polk analysis. Despite the wearing out of cars in use, Arkansas, California, Utah and Oregon registration totals have actually increased. Disporportionate declines of 20 per cent or more have been registered in Indiana, Missouri, New York, Illinois, New Hampshire, Pennsylvania and South Dakota. Generally speaking, the East and Midwest have suffered the heaviest wartime decline in car population, while the South and West Coast regions show a lesser drop, due evidently to population shifts.



Steel Ingot Production by Districts and Per Cent of Capacity

Week of	Pittsburgh	Chicago	Youngstown	Philadelphia	Cleveland	Buffalo	Wheeling	South	Detroit	West	Ohio River	St. Louis	East	Aggregate
December 5....	92.0	101.0	93.0	96.0	98.5	90.0	91.5	99.0	100.0	92.5	106.0	94.5	98.0	95.5
December 12...	92.0	101.0	94.0	96.0	94.0	102.0	91.5	99.0	100.0	92.5	96.0	94.5	90.0	96.0

* Revised

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Affiliate of The Cleveland Worm & Gear Company, Industrial Worm Gearing
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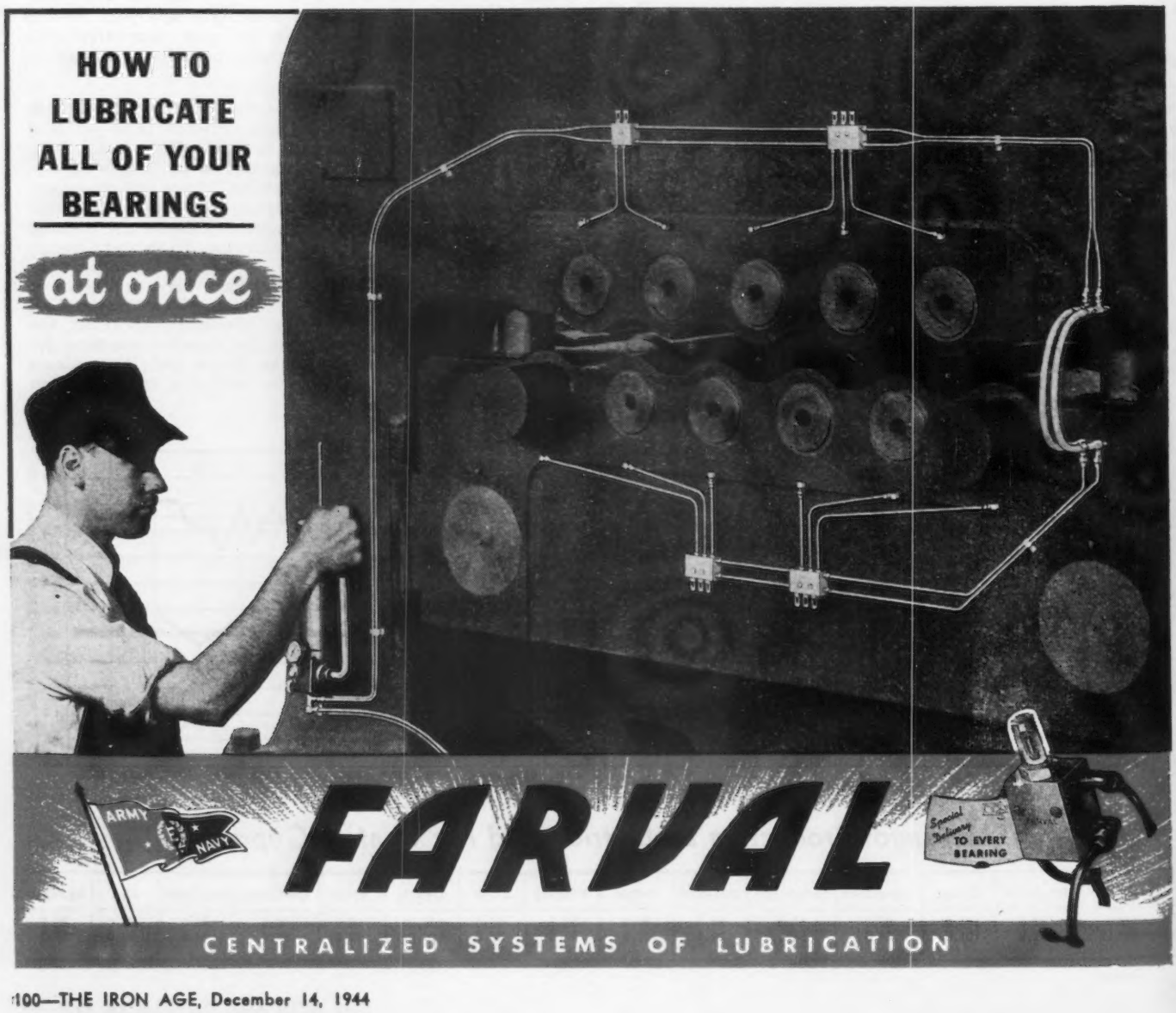

Support Seen for Steel Mill Equipment Market

Pittsburgh

By T. E. LLOYD

• • • **While steel mill** equipment builders are looking to export markets, especially Russia, for a large percentage of their postwar business, they have evidence that steel mill construction in this country is not finished and the rehabilitation of steel mills will be an important phase of the postwar period.

Already, at least one steel producer has placed inquiries for the construction of a steel plant with both converter and open hearth capacity. The intention is likely to utilize the bessemer for producing partially blown metal and then duplexing it in the open hearth. However, there will be facilities provided for casting bessemer blown steel should the occasion demand. Also included in this plan are adequate hot metal holding facilities.

Another steel plant is figuring on completely revamping its bessemer department, with possibly new converters and new equipment throughout. A third company has already received delivery on a converter to be added to its present capacity at one of its plants. This converter is reported to be a new type unit that is totally different from anything ever before produced, in so far as construction is concerned.

Under the classification of rehabilitation of domestic plants comes a phase that has been confronting steel producers for some time—enlargement of individual open hearth furnaces. While the rebuilding of furnaces to their normal rated capacities presents no particularly difficulty engineering problems and

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is handled usually by structural steel fabricators, the enlargement of furnaces requires complete engineering almost from the ground up and is in many ways similar to the construction of new open hearth shops.

The small open hearth furnace for regular routine steel production is generally conceded a thing of the past, and many producers have come to the conclusion that any furnace of under 200 tons capacity is not economical. Therefore, with the trend toward larger open hearth units, there is a fertile market in this field for some years after the end of the war. Some inquiries have already been placed for this type of work.

Russian business is expected to sustain high operations in the steel mill equipment field for some years after the war. Already, Russia has had delivered the main parts of some 14 or 15 blast furnaces. The parts made in this country consisted of such equipment as the ore bridge facilities, the blast furnace base and mantle assemblies, the heater equipment, the bell units and the hoisting mechanism. The plate assembly and fabrication is being done in Russia.

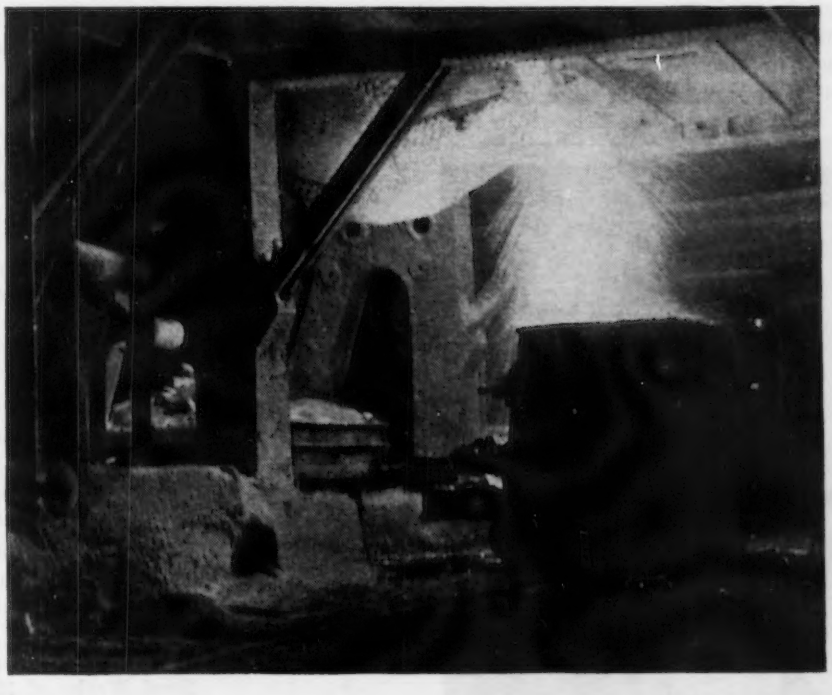
Likewise, at least four complete rolling mills have been sent to Russia, and it is known that the Russian Government is negotiating through the Treasury Department for additional rolling mill equipment. One company recently shipped a 1300-ton hot metal mixer, and two 600-ton mixers are now under construction. Also, several self-powered ladle cars have been shipped, and there are still some under construction.

Another foreign market that has potentialities is the Indian steel industry. Presently, Indian steel capacity is somewhere in the neighborhood of 2,000,000 to 2,500,000 tons a year. While there are no definite inquiries for additional steel making capacity to be built for India, the indications are that India will become more and more a factor in world steel markets.

See THE IRON AGE, *Nov. 30, 1944, page 112, for additional information on India's steel outlook. See pages 102 and 103 this issue on China's steel outlook.*

South American steel expansion seems to have reached a temporary dead end with the approaching completion of the National Steel Co. plant at Volta Redonda, Brazil. Not much in the way of further expansion is being heard from the southern hemisphere, but the capacity to be reached at Volta Redonda next year is only the completion of the first phase in the Brazilian plan to make itself self-sufficient.

FIERY WASTE: *Slag is poured off from a Bessemer converter in a European steel works, now producing girders for U. S. engineer construction on the continent.*



Emotions Blur China's Future Industrialization

New York

• • • **Sincere emotion** and lack of knowledge of conditions are obscuring the gigantic problem ahead for industrializing China along lines envisioned by friends of this Republic. Until Japan is beaten to her knees and until Manchuria is wrested from the Jap's control, there is no chance of China regaining and utilizing what was once the major part of its small iron and steel industry.

Regardless of China's economy and its resources, its industrial future in the postwar period will be definitely tied up with political and trade conditions of the world at that time. If foreign capital for China carries commitments involving the purchase of construction material and machinery outside of China, then the local steel development in China will be impaired. The probability that world steel capacity will, a few years after the war ends, be vastly greater than total world consumption, also will exert its influence upon China's plans for future enlargement of its iron and steel industry.

There seems to be no question that China has raw material resources, but the lack of transportation, skilled labor and the unfortunate successes of the Japs in conquering some of the most productive regions of China, combine to force a conclusion that the job of even partially industrializing China is one far beyond the comprehension of most Western people.

Recent estimates, and most of them can only be estimates, show that China's coal resources are surpassed only by the United States and Canada. Specifically its anthracite coal reserves are believed to be the greatest in the world. All told, China's coal reserves constitute about 78 per cent of the total for Asia.

Many of these resources have been untouched or hardly scratched. In the Shensi Province, where the largest coal reserves exist, the 1931-1935 average production of coal amounted to 269,000,000 tons a year. Estimates on actual coal reserves in this province are estimated at 140,983 millions of tons.

In the Shansi Province, which is the second largest province in coal reserves, there is a woeful lack of transportation. Even though total coal reserves are 79,793 millions of tons, actual output in a recent year amounted to 450,000 net tons, indicating conclusively barriers to greater output.

Official Chinese sources a few years ago, estimated China's iron ore reserves at 1,488,574,000 net tons. A more recent estimate places the iron ore reserves at 1,541,000,000 net tons. Of this total amount of reserves about 1,312,000,000 net tons are in regions either occupied, invaded or penetrated by the Japanese. Some observers are of the opinion that China's prewar iron ore deposits are modest or scant in relation to potentialities of her industrial development. Tables with this story give iron ore statistics.

China's iron and steel industry developed slowly and at the time of the Japanese invasion was still of limited dimensions. The only sizable integrated steel plant was the Showa Steel Works of Manchuria. Units of

Chinese Iron Ore Reserves

Region	Net Tons (000 Omitted)	Per Cent of Total
Manchuria	1,073,290	72.0
Northwestern and Yellow River	177,337	11.91
Yangtse River	122,847	8.25
Western	44,900	3.02
Southeastern	42,300	2.84
Others	27,900	1.88
Total	1,488,574	100.0

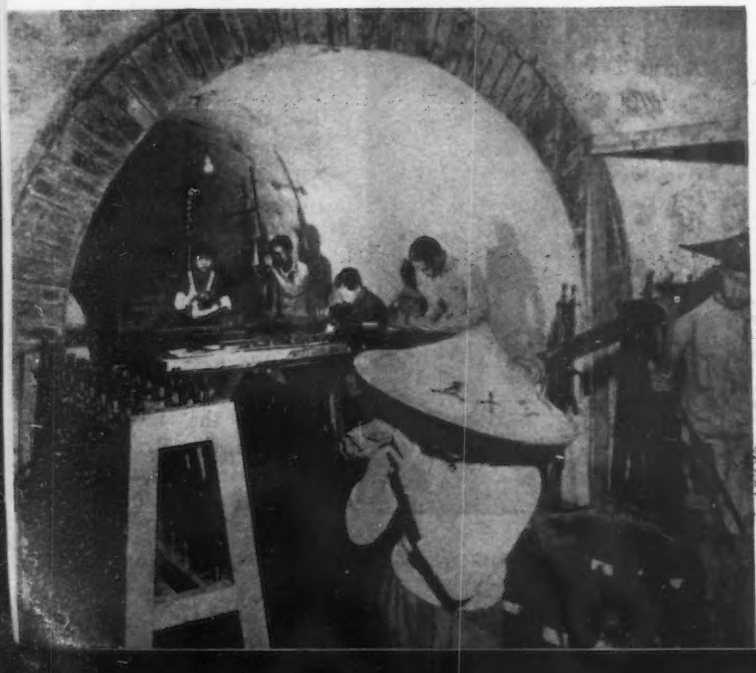
Manchurian Ores (now in Japan's control) are low grade with Fe 30 to 40 per cent and practically all in Lioning Province. Rich deposits are in Yangtse River and Southwestern with Fe 50 to 60 per cent and in Northwestern and Yellow River with Fe 55 per cent.

Chinese Iron Ore Output

Thousands of net tons

Area	1931-35 Average	1936
China Proper	1444	1477
Manchuria	1245	2100
Total	2689	3577

Before the Sino-Japanese War almost all exports went to Japan. Net national supply (output less exports) were: 1931-35 average, 2,148,000 net tons; 1936, 2,709,000 net tons. Prices (U. S. dollars) at Seaport were: 1931-35 average $1.77 a ton; 1936, $1.73 a ton.



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INSIDE CHINA —*Shown here is one of the weapon inspection chambers carved out of solid rock below a mountain. Workmen at the table are doing a final inspection job on weapons produced by the underground arsenal.*

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Problem . . .

. . By TOM CAMPBELL . .

plants in China proper, exclusive of Manchuria, were primarily pig iron producers, making only a small amount of steel. In addition to Showa, there was the Panchihu Iron & Colliery Co. plants in Manchuria. Both of these steel companies have expanded tremendously since 1935, owing to the war. They were never profitable and were utilized chiefly for the Japanese war machine. It is also significant that they were producers only of primary steel—ingots and semi-finished shapes — which found their way to Japan for processing into finished steel items.

Sites of Chinese steel plants according to some authorities have been ill chosen with respect to assembly costs for coal and iron ore. The greatest consumption of steel in China is in the coastal areas. Likewise some of the more important coal reserves are located near the coast, away from iron ore deposits. This has given rise to some opinion that if the ore of India was combined with the coastal coal of China at seaboard steel plants, the result might be more economical and progressive than using China's own iron ore resources which are located far from coal deposits.

An analysis of coal reserves which are not located far from iron ore deposits line up somewhat as follows: Coal reserves, 3,519,000,000 net tons; iron ore deposits, 1,139,248,000 net tons. This, contrasted with earlier figures on total reserves shown above, indicates the dislocation of iron ore deposits with respect to coal reserves or vice-versa.

It is believed by some authorities that because of the distance in location between coal reserves and iron ore reserves, China's future steel possibilities lie in small, widely scattered steel plants. The fact that iron ore deposits are limited in size also favors this viewpoint. Two projects for new steel plants which were under active consideration before the war included one at Tuengpientao in Manchuria and the other at Canton in Ewangtung.

At the present time there are 10 steel plants in China, including Manchuria, the ones in China proper being small and practically all pig iron producers. There are two plants in the Yangtse River Delta; three in the Shanghai District; two in the northwestern region, and two in Manchuria.

Projected plants according to latest information showed three slated for China proper and one for Manchuria, two of these four having been mentioned above. At the present time Free China, exclusive of Manchuria, has 12 blast furnaces and five steel furnaces. Annual capacity for pig iron is 140,000 tons; for steel, 10,000 net tons annually. Manchuria is now believed to have an annual pig iron capacity in excess of 2,500,000 tons and a steel capacity in excess of 800,000 tons a year.

Mr. Nelson and his steel and production experts who are now in China, while expected to lay the groundwork for a Chinese WPB, will find plenty of latitude for their specific abilities. Their problem however will probably be one of immediate concern for current Chinese production difficulties. While some effort and study will no doubt be placed in the feasibility of increasing China's steel output, that problem even though tackled immediately will have little effect on steel production from a tonnage standpoint. This is based on the fact that most of China's steel facilities are now in the hands of the Japs.

Reports have been current that this American production delegation will be in China for a relatively short time which gives credence to the belief that current problems are the foremost issue. From the Chinese statistics described above, it seems quite clear that the future or postwar industrialization of China engenders obstacles that will take time, patience and diplomacy to combat let alone overcome.

Chinese Pig Iron and Steel Output
1931-1941 Net Tons 000 Omitted
(Actual and estimated from reliable sources)

Year	Pig Iron			Raw Steel		
	China Proper	Manchuria	Total	China Proper	Manchuria	Total
1931	150	376	526	17	...	17
1932	170	405	576	28	...	28
1933	190	477	667	28	...	28
1934	171	523	694	55	...	55
1935	101	669	770	49	151	200
1936	74	696	770	32	378	410
1937	43	837	880	32	468	500
1938	...	...	...	...	...	...
1939	85	935	1020	7	638	645
1940	...	...	...	...	...	...
1941	132	1520	1652	10	582	593

Before the Sino-Japanese War China's total capacity was: pig iron, 2,000,000 net tons; steel, 1,000,000 net tons. Today Free China has about 140,000 net tons of pig iron capacity and slightly more than 10,000 net tons of steel. Assuming after Japan is crushed and Manchuria steel mills are intact, China's capacity may be: Pig iron, 2,900,000 net tons; steel, 900,000 net tons.

Peak Steel Tonnages In Prewar Years Far Below Current Output

New York

• • • **The peak tonnages of steel** which went into construction projects, automobiles, home appliances, farm equipment, machinery, containers and other basic products of American industry in any year of the prewar period add up to only about two-thirds as much steel as will be produced in 1944, according to the American Iron & Steel Institute.

All told, about 37,256,000 tons of finished steel would have been consumed if the peak production years for each of such basic products had occurred simultaneously. That, of course, did not happen. For 1944, it is estimated that total shipments of finished steel from steel plants to all consumers will exceed 62,000,000 tons.

Consumption of steel in peak years by every steel-consuming industry has not been estimated for lack of data. The maximum consumption of steel for all purposes including export in a year unaffected by war was reached in 1929 when about 45,500,000 tons of finished steel were produced.

Study of annual production records of the various industries indicates individual output peaks are spread out over eight different years, from 1923 through 1941.

Passenger automobile production in the peak production year 1929 consumed about 7,800,000 tons of steel. In 1937, the peak year for commercial truck production, 2,233,000 tons of steel were used by truck manufacturers.

Construction of all kinds reached a prewar peak in 1929, requiring a total of about 8,643,000 tons of steel. Residential construction, however, reached its peak in 1925 when about 1,575,000 tons of steel went into the building of one and two-family residences, including their heating systems.

Railroad locomotive and freight car building each hit a peak in 1923. An estimated 3,118,000 tons of steel went into freight cars that year, and another 880,000 tons into locomotives. In 1926, passenger car production reached its peak, requiring 133,000 tons of steel. Steel rails and track accessories also reached their post World War I production peak in 1926 with production of 5,236,000 tons.

The year 1941 is the biggest year on record for the home appliance field. Mechanical refrigerators that year accounted for about 439,000 tons of steel, kitchen ranges for 303,000 tons and washing machines for 131,000 tons.

Production of steel barrels and drums reached its prewar record in 1940 when 327,000 tons of steel were accounted for. In 1941, production of other types of steel containers, principally tin cans, consumed about 3,185,000 tons.

Likewise in 1941 the production of farm machinery and equipment rose to record levels, consuming an estimated 1,553,000 tons of steel.

The best recent peacetime year for shipbuilding and repairing was 1939, with steel consumption estimated at 489,000 tons. That same year was the peacetime peak for production of machinery and tools, consuming about 1,000,000 tons of steel.

Oil, gas and mining in general reached about their highest level of prewar activity in 1940. Steel consumption in those fields was estimated at 1,786,000 tons.

Restrictions Lifted For Color Finishes On Metal Equipment

Washington

• • • **Effective Nov. 29,** WPB adopted an amendment to L-108 permitting a variety of color finishes on metalworking equipment, such as ammunition and cartridge case machinery, lathes, planers, bolt, nut, rivet and screw machinery and machines for drilling, gear cutting, etc.

Since May 1, 1942, L-108 has restricted the color of metalworking equipment to "old machine-tool gray" for final paint, enamel or lacquer coatings, notwithstanding customers' requests for other colors.

The manpower saving involved in the order justifies its retention until V-E Day, tools division officials said. It continues to restrict the number of coats of paint, enamel or lacquer on metalworking equipment, they added. The order now permits application of only one coat of primer or sealer and not more than two coats of paint, enamel or lacquer. No filler may be applied to smooth out irregularities in metal surfaces, according to the order. The amendment will permit manufacturers to finish their machines in preferred lighter colors, which increase light intensity at the working levels of machines and provide greater safety for workers, it was pointed out.

Pipe Industry Group Asks Postponement Of Increased Inventories

Washington

• • • **Because of increasing** heavy ammunition requirements, the Pipe Industry Advisory Committee at a recent meeting recommended that the proposed increase in steel mill pipe inventories be postponed. This action, WPB said, followed disclosure by Steel Division officials that the expanding shell program had crowded bar, rail and structural mills to capacity and might fan out to include the seamless pipe mills.

Seamless pipe, it was pointed out, may not only be reduced through direct curtailment of facilities, but mills used for rolling bar rounds and supplying hot topped steel may cut supplies of this product still further.

The proposal to increase inventories of oil country pipe at the steel mills from 20,000 to 115,000 tons was submitted at this meeting by PAW officials. A PAW spokesman said the proposed increase would actually lower inventory needs for oil country pipe, since a centralized 115,000-ton mill stock could be utilized to greater advantage by the oil country trade than could inventories scattered among some 16,000 oil producers.

Committee members also reviewed current steel warehouse stocks of pipe and after consulting inventory reports shown by the Steel Division's warehouse branch, decided that supplies were adequate to meet current essential needs.

October Alloy Steel Output Tops September

New York

• • • **Production of alloy steels** during October totaled 842,392 tons, about 11 per cent of total steel production during that month, according to the American Iron and Steel Institute.

In September, 840,575 tons of alloy steel were produced. In October a year ago alloy steel production was 989,432 tons.

In the first 10 months of 1944, alloy steel production totaled 8,874,012 tons, compared with 11,432,939 tons in the corresponding period of 1943.

Open hearth furnaces produced 556,612 tons of alloy steel in October. The remaining 285,780 tons of alloy steel production came chiefly from electric furnaces.

Administration Seen As Main Task Ahead On Contract Closings

Detroit

• • • **New methods and new** approaches to make more simple the job of contract termination—and new and capable personnel to carry out these policies—are being developed by the Office of Contract Settlement to meet the forthcoming job of unwinding the war program, the Economic Club of Detroit was told in a recent address by Robert H. Hinckley, director of OCS.

The main task ahead, said Hinckley, is one of administration—getting the basic rules down to the operating level, both in the contracting agencies and in the office and plants of contractors. "There is a vast difference between preparing a regulation in Washington," he said, "and having that regulation do its job in settling a contract in Detroit or Los Angeles.

Speed in settling terminated contracts is vital to the maintenance and increase of war production, he pointed out. He characterized speed as the most important function of contract settlement, and said this would continue to be so until after victory, so the way would be clear to resume peacetime production. The other main objective of contract settlement he described as "fairness to the Government and the contractor alike."

"The Government," he said, "having gotten business into war production and constantly demanding new and greater production, is well aware of its obligations to war contractors and their workers. The Government is ready, willing and eager to pay claims on terminated war contracts."

He described standard settlement proposal forms which have been developed and are now in use for all fixed price war supply contracts and sub-contracts. He described these as "a tremendous step forward" because of their simplification and definition of the rules under which contractors make up and present claims. He mentioned also the speeding up of the principle of delegating to prime contractors the right to make settlements with their sub-contractors.

The speaker made mention, also, of clearance, a subject of the highest interest in Detroit. "The contract settlement act," he said, "requires the contracting agencies to clear contractor's plants within a maximum period of 60 days from the filing of an inventory list with the Government. The joint termination regulation of the War and Navy Departments provides that, where practicable, the contracting officer will inform the contractor, within twenty days of the filing of this list, what material the Government wants, what the contractor may retain, and what may be scrapped. It is industry's responsibility to file this inventory list; it is Government's responsibility to act after these lists have been received. Thus, to a major degree, industry has the plant clearance time within its own control. It need not wait for maximum periods to expire. Moreover, pre-termination agreements can be worked out now which will speed most phases of plant clearance when termination comes."

Hinckley admitted that several unsolved problems still remains, typical of which is the method of providing fair compensation to a sub-contractor when his prime contractor goes bankrupt.

Three Nations Seek Dismantled Units Of Pineacres Buildings

Buffalo

• • • **England, France and** Belgium are negotiating for dismantled units of the Pineacres governmental housing project in Niagara Falls, to be used in rehabilitating war-torn areas, Charles S. Ascher, regional representative of the National Housing Administration revealed recently.

Several of the 16-family structures literally were sawed in two and moved to nearby sites in order to see if it could be done and what the cost would be. This experiment is expected to supply the cost data which will figure in the government's negotiations to dispose of the buildings.

COMING EVENTS

Jan. 8-12—SAE Annual War Engineering Meeting, Detroit.

Jan. 10-11—Institute of Scrap Iron & Steel, Inc., annual meeting, Cincinnati.

Jan. 24-26—National Screw Machine Products Association, annual meeting, Milwaukee.

March 19-20—American Society of Tool Engineers, Cleveland.

March 19-22—Machine and Tool Progress Exposition, American Society of Tool Engineers, Cleveland.

April 4-6—SAE National Aeronautic Meeting, New York.

April 12-14—Electrochemical Society, Inc., Philadelphia—Atlantic City Congress, Atlantic City, N. J.

April 30-May 4—American Foundrymen's Association, Detroit.

Relaxation of Rules After V-E Day Urged By Machinery Group

Washington

• • • **Members of the industry** advisory committees representing construction machinery manufacturers at a recent meeting, concurring in suggestions made by WPB officials, recommended removal of all present controls over the manufacture and distribution of such machinery after the end of the war in Europe, with the provision that only up to 75 per cent of the production of critical items and critical repair parts be reserved for the military if required.

L-192, which controls the manufacture and distribution of construction machinery, now requires the producers to manufacture under approved production schedules, or under specific authorization from WPB. WPB officials said that currently military requirements are taking approximately 75 per cent of the overall production, with 100 per cent of the production of some items. Between 90 and 100 per cent of all new power cranes and shovels are going into the war effort, while it is taking 75 per cent of the motor graders and 85 per cent of tracklaying tractors.

WPB Restricts Model Passenger Car Output

Washington

• • • **WPB announced on Dec. 8** that experimental models of passenger automobiles cannot be made except under the restrictions of Priorities Regulation 23. They are not permitted to be made under Supplementary General Limitation Order L-2-g, WPB pointed out, and in order to clear up some misunderstanding on the part of automobile manufacturers, Interpretation 1 to Order L-2-g was issued to clarify this point.

Order L-2-g, issued Jan. 21, 1942, prohibits the manufacture of passenger automobiles "either for civilian or for military use or for export." Under Interpretation 1, the making of an experimental model is regarded as manufacture for civilian use, WPB said.

Priorities Regulation 23 covers experimental models of consumer or industrial products and hence experimental models of passenger automobiles may only be made under that regulation, it was pointed out.

UAW to Vote by Mail On No Strike Pledge

Detroit

• • • **The 1,200,000 members** of the CIO United Automobile Workers Union will vote by mail in January and February on the question of whether to renew or rescind their no-strike pledge, in effect since the war began.

Ballots will be mailed to the membership about Jan. 15. Returned ballots must be postmarked not later than Feb. 17, although service men will be given until Feb. 28 to make their returns. It is expected that final results will be available somewhere around Mar. 15.

Informed opinion within the union anticipates an upholding of the no-strike pledge, center of a bitter two-day dispute at the union's convention at Grand Rapids last September. At that time the 2500 delegates indicated their uncertainty over the course they should take by voting down in succession proposals to abrogate the pledge entirely, to modify it so it would be applicable only to war plants, and to maintain it. After the failure of any of these propositions to capture a majority, the referendum was decided on.

American Iron & Steel Institute Capacity, Production and Shipments

STEEL PRODUCTS	Number of Companies	Items	Maximum Annual Potential Capacity, Net Tons	OCTOBER, 1944 Production Net Tons	OCTOBER, 1944 Production Per Cent of Capacity	OCTOBER, 1944 Shipments (Net Tons) Total	OCTOBER, 1944 Shipments (Net Tons) To Members of the Industry for Conversion into Further Finished Products	TO DATE THIS YEAR Production Net Tons	TO DATE THIS YEAR Production Per Cent of Capacity	TO DATE THIS YEAR Shipments (Net Tons) Total	TO DATE THIS YEAR Shipments (Net Tons) To Members of the Industry for Conversion into Further Finished Products
Ingots, blooms, billets, tube rounds, sheet and tin bars, etc.	50	1				706,949	226,438			7,291,659	2,408,360
Structural shapes (heavy)	10	2	9,179,250	327,147	45.5	306,016		3,283,005	44.2	3,180,722	
Steel piling	4	3		26,493		22,184		97,415		93,586	
Plates (sheared and universal)	26	4	16,883,220	1,029,452	72.0	1,013,199	56,241	11,098,989	78.9	10,803,142	558,568
Skelp	6	5				70,591	57,399			697,557	550,036
Rails—Standard (over 60 lbs.)	4	6	3,625,000	199,980	65.1	197,310		1,923,437	63.7	1,905,547	
—All other	6	7	526,000	17,327	38.9	16,519		159,325	36.3	164,564	
Splice bars and tie plates	13	8	1,747,260	60,713	41.0	61,129		659,220	45.3	673,515	
Track spikes	10	9	350,640	12,321	41.5	12,670		122,720	42.0	130,230	
Hot Rolled Bars—Carbon	39	10		710,544		567,442	96,444	7,247,752		5,980,505	806,610
—Reinforcing—New billet	15	11		54,255		51,042		419,208		444,371	
—Rerolled	14	12		6,274		5,368		58,513		67,219	
—Alloy	25	13		243,886		191,955	36,610	2,573,434		1,891,335	362,699
—Total	47	14	22,296,230	1,014,959	53.7	815,807	133,054	10,298,907	55.4	8,383,430	1,169,309
Cold Finished Bars—Carbon	24	15		153,109		151,723		1,494,058		1,488,054	
—Alloy	23	16		33,763		28,622		353,633		319,999	
—Total	30	17	2,935,950	186,872	75.1	180,345		1,847,691	75.5	1,808,053	
Tool steel bars	17	18	271,460	12,827	55.8	12,651		122,048	53.9	116,359	
Pipes and Tubes—Butt weld	16	19	2,162,520	126,710	69.1	124,565		1,196,575	66.4	1,195,013	
—Lap weld	8	20	842,200	48,841	68.4	46,846		480,913	68.5	479,331	
—Electric weld	9	21	1,299,900	66,562	60.4	64,709		683,679	63.1	677,376	
—Seamless	15	22	2,678,100	202,741	89.3	192,524		1,953,071	87.5	1,962,706	
—Conduit	7	23	187,000	5,626	35.5	6,797		50,190	32.2	50,614	
—Mechanical tubing	12	24	1,050,400	65,641	73.7	65,974		685,277	78.3	672,541	
Wire Rods	27	25	7,015,470	390,506	65.7	115,112	30,702	3,854,209	65.9	1,156,661	371,422
Wire—Drawn	42	26	5,653,440	310,381	64.8	185,866	6,351	3,056,438	64.9	1,812,442	84,975
—Nails and staples	19	27	1,249,020	48,689	46.0	47,369		546,826	52.5	536,375	
—Barbed and twisted	15	28	546,390	21,568	46.6	20,766		211,959	46.5	209,413	
—Woven wire fence	16	29	1,106,200	32,812	35.0	31,049		318,932	34.6	313,860	
—Bale ties	12	30	152,500	6,233	48.2	6,214		64,724	50.9	63,203	
Black Plate—Ordinary	9	31				44,205	115			409,407	1,023
—Chemically treated	8	32	464,000	6,130	15.6	6,144		112,728	29.2	106,488	
Tin and Tern Plate—Hot dipped	9	33	3,718,850	185,766	58.9	163,212		1,648,315	53.2	1,669,625	
—Electrolytic	10	34	2,173,850	47,251	25.7	41,683		537,068	29.6	499,734	
Sheets—Hot rolled	29	35	19,536,820	1,106,769	66.9	560,802	37,064	10,610,240	65.2	5,373,952	236,812
—Cold rolled	13	36	7,234,260	350,927	57.2	186,920		3,130,578	51.9	1,681,503	
—Galvanized	15	37	2,892,130	132,280	54.0	130,227		1,123,142	46.6	1,112,652	
Strip—Hot rolled	23	38	7,101,400	227,266	37.8	148,531	21,271	2,245,571	37.9	1,432,281	227,884
—Cold rolled	35	39	2,879,310	104,391	42.8	98,270		1,006,436	41.9	943,505	
Wheels (car, rolled steel)	5	40	319,400	28,628	105.8	29,026		248,722	93.4	245,156	
Axles	6	41	408,170	15,005	43.4	15,273		166,709	49.0	161,991	
All other	5	42	168,790	4,853	33.9	4,693		40,456	28.8	39,867	
TOTAL STEEL PRODUCTS	154	43				5,752,147	568,635			58,054,060	5,608,389
Effective steel finishing capacity	154	44	64,722,000								
Per cent of shipments to effective finishing capacity	154	45				94.5%				97.2%	

During 1943 the companies included above represented 98.9 per cent of the total output of finished rolled steel products.

Ryerson Argues Case For Price Revision On Steel Products

Chicago

• • • **Paced by wage advances,** a variety of causes require a higher price schedule for the steel industry, Edward L. Ryerson, chairman of Inland Steel Co., stated recently.

"Some people seem to believe that the steel industry can absorb any number of wage advances without increasing prices. This is, of course, impossible if the industry is to remain solvent," he declared.

"Our present schedule of prices remains unchanged since 1939. Yet, we have already had two general wage advances, and under the recent War Labor Board directive, we will have to make additional upward adjustments. The latter, though indeterminable, will be substantial.

"Besides the wage increases, our costs have risen due to a variety of other causes, including advances in the prices of many of the materials we purchase. As a result, our operations show direct losses on a number of products, and this must be true in the steel industry as a whole.

"In addition, the steel industry, as a result of its frozen price schedule, is not showing a rate of return on invested capital commensurate with that of industry generally. In this connection, a recent survey by the National City Bank of New York shows that in the first nine months of 1944, 26 iron and steel companies had earnings which reflected an annual rate of 4.9 per cent on net worth, as compared with 8.9 per cent for 245 companies in various manufacturing activities.

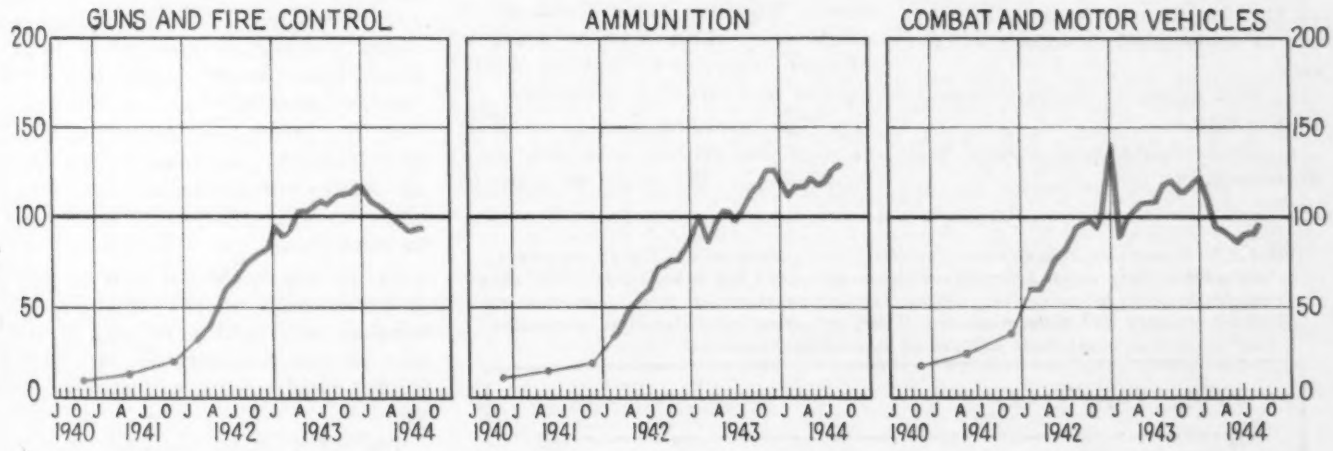
"Surely, no one can justify discrimination against one particular industry. It would, therefore, seem clear that the steel price schedule should be properly adjusted if sufficient risk capital is to be attracted to this key industry, in order that it may be prepared to provide a high level of employment in the postwar period."

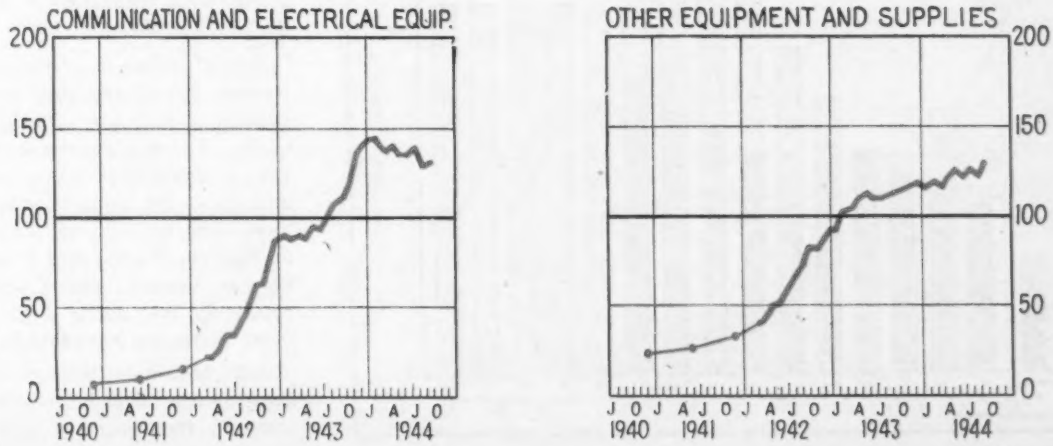
New General Counsel Named

Washington

• • • **Frederick M. Eaton,** New York, WPB solicitor, has been named to succeed John Lord O'Brian who resigned Dec. 20 as WPB general counsel. Laurence M. Lombard, Boston, will succeed Mr. Eaton as solicitor. Mr. Eaton has been active in the legal work of WPB and its predecessor agencies since June, 1940. Mr. Lombard has been a member of the legal staff for three and a half years.

ALL IS CHANGED NOW: *The need for war materials is now in the forefront owing to the tough fighting in Europe. All divisions of the Armed Forces are rearranging and upping their munition programs. The indexes shown below are the most recent detailed ones but it is expected that in coming months all of them will point more sharply upwards. Nothing is to interfere with prompt output of war materials.*




COMMUNICATION AND ELECTRICAL EQUIP.
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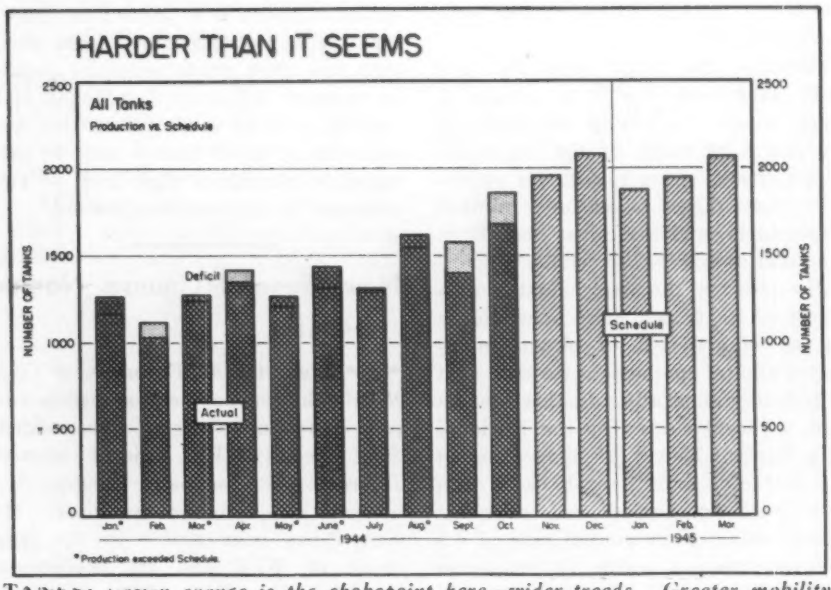


TANKS: *Design change is the chokepoint here—wider treads. Greater mobility and firepower needed in new models—castings deliveries influenced by labor shortage in foundries.*

Washington

• • • **H. G. Batcheller,** WPB Chief of Operations, reported to the Board on Dec. 7 the following reasons for production lags in critical war programs:

1. Controlling reasons for critical shortages, as previously noted, are:

a. Upsurges in immediate and near-term requirements above the capacity of the facilities or labor skills that can be made quickly available—40 per cent.

b. New models or design changes—26 per cent.

c. Labor shortages in critical programs—22 per cent.

d. Facilities shortages—12 per cent.

2. Some of these factors are within the sole control of the procuring agency. Others require and are receiving cooperative action of the civilian agencies. All can be minimized or eliminated.

3. In almost all critical programs there are individual plants needing labor. Wherever labor shortages do exist, every effort must be made to fill them, including prompt use of ceilings on less essential production.

4. The immediate task is to tackle each of the critical programs on a "spot" basis. Wherever we know of lagging plants we must send in practical production specialists, not general practitioners, to determine the facts, the causes, and the probable cures of production troubles.

5. We must keep a continuous watch on all lagging programs to make sure that they do not become critical. Preventive measures can and must be taken for each program or plant once the causes are determined.

6. Vastly expanded production of almost any item can be achieved, with minimum harmful effect on other programs, if WPB has notice of the coming needs in sufficient time to take the necessary preparatory industrial steps.

7. There should be better coordination between WPB, WMC and the services on contract run-outs or cutbacks, and new contract placements. A much better job needs to be done in diverting released facilities and labor into critical plants.

8. Both WPB and WMC must improve their methods of supervision and compliance to avoid leakage of critical components and critical man-hours from "must" plants into less essential production.

9. The production troubles we face in a relatively few critical programs are neither unusual nor new. We either know, or can quickly learn, how to solve them.

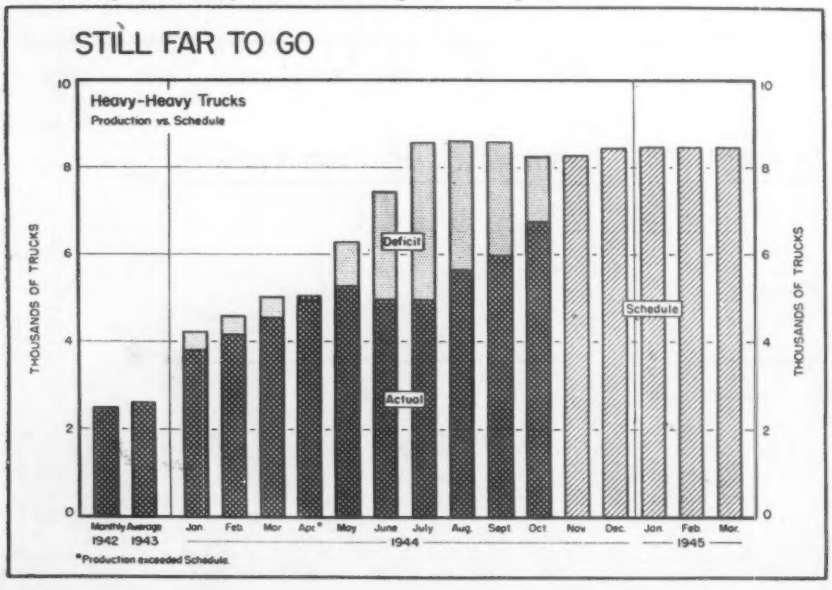
10. So long as the war lasts, so long as commanders in the field are developing new tactics, so long as inventors and scientists are at work, critical requirements will always develop.

The WPB official furnished details on the problems faced in certain fields along with information on new production schedules.

Superfortresses—"Kinks have to be worked out of the production control system at Bell Aircraft Corp., Marietta, Ga. A new plant manager who took over in September was recently killed, and must be replaced. Boeing must have 3500 or 4000 additional workers at Renton, Wash., and Glenn L. Martin Co., Omaha, whose wage scale is relatively low needs 2000 workers to meet increased schedule."

A-26 Invader—"Design changes are dogging the Invader as first reports come in from combat theaters. It's

TRUCKS: *Manpower difficulties in foundries and greatly boosted program—industry now making more heavy trucks a month (6800 but schedule is 8009) than made in year in peacetime. Most critical components from foundries are axles, engines and transmissions. WMC is intensifying foundry recruitment and improved component scheduling is contemplated.*



Batcheller Tells of

ls of Short Items

a tricky task and it may be two or three months before production lines are completely changed over. The problem here is to quadruple present production by next July, in the face of tactical design changes.

"Douglas, Long Beach, Calif., turned out Invaders last month, five short of schedule. The other producer Douglas at Tulsa, was on schedule. This plant is about a month behind Long Beach in making design changes."

Douglas C-54 Skymaster — Schedules greatly hiked. October output ran 27 per cent behind W-12. One of the key plants is in Chicago and labor recruitment may be difficult.

Combat Loaders—Manpower shortages and step up are responsible for production lag. Most combat loader yards are on the Pacific Coast where manpower is tight; turnover has been troublesome and yards have had difficulty in getting and keeping mechanics, steamfitters and electricians.

Naval Ship Repair Maintenance and Spare Parts—Manpower shortages exist in the four naval establishments on the West Coast: Puget Sound Navy Yard; Mare Island Navy Yard; Hunter's Point Drydocks in San Francisco; and Terminal Island Drydocks in San Pedro, Calif. Maintenance parts are short with monthly deliveries running at only about 80 per cent of requirements.

Deliveries of Diesel engines have been running $1,000,000 a month behind schedule and this schedule is due to rise from a current average of $12,000,000 a month to $23,000,000 in 1945.

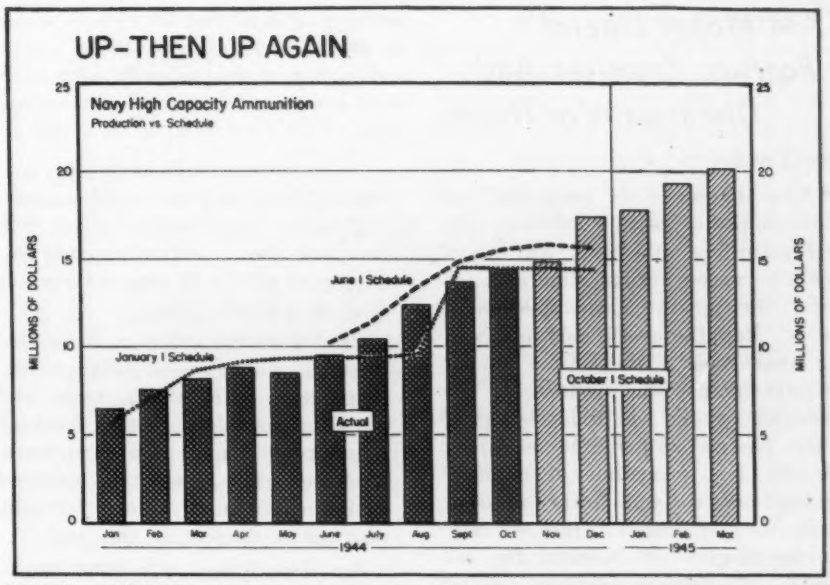
Forgings and Castings—The Steel Division which has been given responsibility for production and distribution of forgings and castings believes there is adequate foundry production for the supply of top urgency programs and will institute whatever steps are necessary to assure distribution of present production. Proper identification of the most important projects will eliminate the principal bottleneck, it is believed. Glamorized higher paying war industries such as shipbuilding and aircraft caused the foundry and forge industry to come out second best in the race for manpower.

Although WLB has granted 1000 individual wage increases and average weekly earnings have gone up to $52, long hours and low pay for unskilled workers contributes to a 16,000 man labor deficit in the foundry industry. Pay for unskilled labor averages between 65c. and 70c. an hour.

On top of this armed forces drained workers and are still cutting into labor supply. Although workers in critical plants are supposed to have preferential treatment in Selective Service, local boards don't always follow instructions. Moreover, an agricultural worker who wants a seasonal job in a forge shop or foundry may lose his draft deferment.

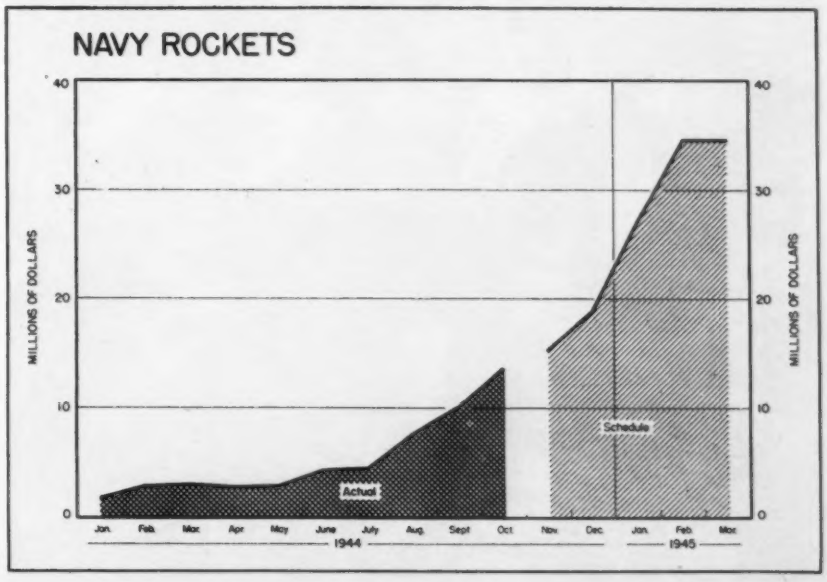
WPB is trying to get a restatement of the essentiality of foundry and forge workers. Further the Army and Navy are now working on a plan to furlough a selected number of men to the forge shops and foundries. And several thousand Jamaicans and Barbadians have been made available to the industry now that their farm work on the WFA program has run out.

Housing is a problem, but is being provided. Moreover, there is prejudice against foreign workers in certain local communities and labor unions.



NAVY SHELLS: *Step-up causing machine tool shortages—insufficient trained manpower and component shortages among new contractors who are one to three months late in making initial deliveries—old contractors generally on schedule.*

NAVY ROCKETS: *Step-up causing machine tool shortages. Following components are short: Electric motors and electrical equipment, conveyors, compressors, hoists and hydraulic equipment are also needed. Current rocket production is eight times that of the first quarter.*



NAM Makes Liberal Postwar Promises And Discusses War Needs

New York

• • • **In the midst of accepting** the responsibility of getting out more and more munitions and other war items urgently needed abroad American industry, through the National Association of Manufacturers meeting here last week took a short time out to make specific postwar promises.

Looking beyond war today business leaders pledged 25 per cent more jobs over the last peacetime year, more earning power, and lower product prices to the nation after victory in order to give war workers the assurance of economic security needed to keep them on the job now.

The formal pledge was made at the War and Reconversion Congress of American Industry sponsored by the NAM. The Congress, convened last week, emphasized industry's current national program of "Producing for Victory—Preparing for Peace."

Industry, stating that every resource now mustered for victory would be used to create better living standards and economic security after war, went on record before the American people with the following three points:

1—Americans will have jobs. And management will take bold, aggressive action in expanding production to create them. Manufacturing employment will be 25 per cent greater than in prewar years.

2—Americans will earn more. Industrial management will provide employees with better tools and working conditions so that workers may produce, and thus earn more. Manufacturers already have placed 2-billion worth of orders for new postwar equipment to this end.

3 — Americans will buy more. Management will strive to improve production and distribution to make better goods available at lower prices.

Industrialists at the NAM meetings heard WPB Chairman J. A. Krug and Lieut. Gen. Brehon Somervell describe the urgent need for more ammunition. Both emphasized that 40 per cent of war production lags with 27 per cent was in the "critical category." Both stressed the need for 300,000 additional workers needed to make sure the Armed Forces' demands are met. Although the NAM meeting had been called primarily as a clinic for postwar endeavor it quickly developed also into a spontaneous symposium on getting out additional war goods.

In a little more than three months after Normandy D-Day, said Gen. Somervell, three American armies in France fired 300,000,000 rounds of small arms ammunition, 4,426,000 rounds of 105 mm. ammunition, 1,248,000 rounds of 155 mm. shells and 3,500,000 rounds of mortar shells.

In one month these armies lost from all causes 83 per cent of their dump trucks, 50 per cent of their mortars, 14 per cent of their scout cars and 10 per cent of light and medium tanks.

In North Africa, the general said, our forces expended 42,000 rounds of mortar ammuntion a month. In 10 days in October our armies in France fired 1,300,000 rounds.

Gen. Somervell acknowledged industry's great job in making 1,800,000 trucks, 68,000 tanks, 2,800,000 big and medium guns, 15,000,000 machine guns and rifles, 43,000,000 rounds of ammunition, 196,000,000 uniforms and 187,000 planes.

But, he said, U. S. armies "are using some parts of the reserves we were able to build up before the fighting reached its present intensity faster than we can replace them."

RECONDITIONING JOB: *Engines received for repair at the General Motors operated base near an East Indian port are checked for missing or extra parts before entering the plant for rebuilding.*

Ravenna Arsenal To Make Heavy Artillery

Ravenna, Ohio

• • • **Conversion of the huge Ravenna** Arsenal to the sole production of heavy artillery shell and bombs, as the result of serious ammunition shortages, was announced recently.

Lieut. Col. Claron W. Meldrum, commanding officer of the shell loading plant, said that under government orders, the plant's "load line 1," previously a major producer of 75 mm. shell, had been converted to the production of shell 4.5 in. in diameter or greater. Official production figures for this load line have never been given, but it has been unofficially estimated at around 1,000,000 shell a month.

Simultaneously, it was learned that a shortage of shell casings is preventing the shell loading plant from loading to its present capacity.

Krug Answers Senate Quiz On Manpower-Production Problems

Washington

• • • **"If we could** cut down turnover, absenteeism, get a small increase in employment, we would have this thing solved" WPB Chairman J. A. Krug predicted Dec. 7 in giving his solution to the manpower shortage to the Mead (Senate) Investigating Committee.

However, he said that he was not sure that "if we froze all the turnover out that we would solve the problem."

"The problems of dealing with that are extremely difficult. I don't think that you can generalize on them," he declared.

Mr. Krug, who presented charts taken from the report on critical programs by WPB Chief of Operations H. G. Batcheller, said that he did not favor enactment of national service legislation now.

"I think if Congress would give specific authority to enforce the manpower regulations it would help greatly, and while that is not my first responsibility, I certainly would advocate that," Mr. Krug concluded.

WMC Deputy Chairman Charles M. Hay who testified before the Committee on Dec. 8, said immediate manpower requirements are 90,000 workers.

Lieut. Gen. Brehon B. Somervell had said on Dec. 4 that there is a need for ASF critical programs alone, 311,479 additional workers.

Said Mr. Hay: "If we had these 300,000 additional people today, and were able to say to the employers, 'Here are your 300,000 men,' they wouldn't know where to put them.

"As we figure it, the best estimate we can make is about 140,000 or 141,000 are needed within the next few weeks, but as facilities are brought in, we will have to step-up and meet the demand for 300,000." He later revised his immediate need to 90,000.

Quit or turnover rates in August and September were 56 per thousand workers per month. This is a comparatively low rate, Mr. Hay told the Committee, but added that quit rates are too high in "must" plants producing critical items.

He cited one shipyard where the separation rate was 19 per cent per month, and one foundry had a separation rate of 26 per cent.

However, Mr. Hay told THE IRON AGE that turnover in all other manufacturing industries was 39 per cent higher than in munitions industries. BLS officials have said that the higher rate in all other manufacturing industries is induced by and a direct result of recruitment. These BLS officials believe that the voluntary quit rate is just about equal in munitions industries and all other manufacturing establishments. Hence the quit rate in all other manufacturing industries is increased only by recruitment.

Senator Homer Ferguson, Republican of Michigan, said WMC has not done a good enforcement job on certificates of availability, charging that certificates were being forged on the West Coast in tremendous numbers. Both Mr. Hay and Mr. Krug promised that certificates would be enforced more strictly. Mr. Krug said he thought the reason WMC hadn't been able to enforce certificates better was because "WMC does not have enough manpower."

WPB's efforts to increase production of critical items will consist in four steps, Mr. Krug said. They will be: Periodic meetings with agencies to reach agreement on facts; meetings with industries in critical areas, visits to individual plants where production is lagging; and cooperation with special AFL and CIO committees which have pledged to give assistance in increasing production.

WMC Assistant Executive Director William Haber was asked if it were true that the Maritime Commission is placing additional contracts on the West Coast in shipyards where contracts will run in the next year, while at the same time East Coast yards are being closed, and workers being laid off.

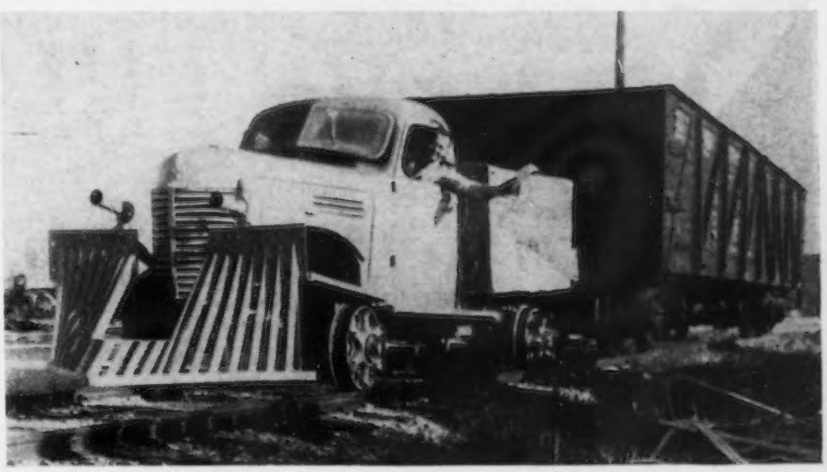
Mr. Haber replied: "We have brought the issue to the attention of the Maritime Commission, and there are always extenuating circumstances involving problems of cost and problems of strategy and problems of management in which, since we have only an advisory power in that connection, we get the short end of the argument."

Senator Ball also asked about excessive union initiation fees as high as $150 for some Minnesota construction workers in their adverse effect on recruitment. Mr. Haber answered that the problem is not easily solved, although WMC had been able to work out agreements with local unions to reduce fees.

On the question of the effectiveness of the Production Executive Committee Staff whose duty it is to see to it that contract terminations are made in tight labor areas so far as possible, Mr. Haber said the procedure is about 50 per cent successful.

Under close interrogation by committee counsel Rudolph Halley, Mr. Haber said that WMC had been unable to find out about cutbacks two or three months in advance. Mr. Haber agreed with Mr. Halley that it is difficult to find out from the services more than five days in advance what terminations were slated to take place.

HATFIELD SPECIAL: *Frank Hatfield, machinist at a Naval Air Station in Louisiana built this hybrid from junked parts for used in general hauling about the base.*



Army Car Program To Be Slashed; Domestic Orders Show Increase

Pittsburgh

• • • **Within the next few days** the Army is expected to cancel its 1945 railroad carbuilding program. Orders for about 26,000 cars will be trimmed down to 4800, all of these going to India. Presently the Army has several thousand finished cars in this country which have not yet been used. These will go into service before any new orders are placed or any outstanding orders are authorized.

In the domestic car market, total orders placed from Oct. 1 to Dec. 1 are about 40,000 cars and since Dec. 1 orders for another 10,000 cars have been placed. These must await approval by the WPB Transportation Equipment Branch before construction will begin.

Of the new orders placed, all of which are for delivery during the second and third quarters of the coming year, the New York Central Railroad has placed the greatest number. Their orders are for 2000 50-ton box cars to be built by American Car & Foundry and 2000 more of the same type to be built at their Dispatch shops. The Pittsburgh and Lake Erie Railroad, affiliated with the New York Central, has on order 1000 70-ton gondolas with Dispatch shops.

The Chicago and Northwestern placed orders for a variety of types and sizes of cars. American Car & Foundry will build for this road 250 70-ton ballast cars and 400 50-ton box cars. Orders for 750 70-ton gondolas were placed with Bethlehem; 500 70-ton hoppers with General American Transportation Co. at East Chicago; 500 70-ton hoppers with Pullman Standard at Michigan City; and 100 50-ton hoppers with Mt. Vernon Car Co., Mt. Vernon, Ill.

The Santa Fe placed an order for 550 box cars with Pullman Standard at Michigan City, and the Chesapeake and Ohio placed orders for 950 box cars with the same plant of Pullman Standard. Pressed Steel Car Co., Pittsburgh, received an order for 500 50-ton gondolas from the Great Northern Railroad and American Car & Foundry received an order for 250 50-ton flats from the same road. The Nickel Plate Railroad ordered 580 50-ton box cars from Ralston Steel Car Co., at Columbus, Ohio.

At present there are only about 2500 car inquiries out. These are for 100 box cars for Santa Fe; 500 50-ton hoppers for the Chicago and Eastern Illinois; 500 50-ton box cars for the Erie; 300 40-ton refrigerator cars for the Fruit Growers Express; 500 40-ton box cars for the Grand Trunk of Canadian National; 500 50-ton auto box for the Baltimore and Ohio; and 100 50-ton box cars for the Western Maryland.

Since the war has taken a heavy toll on rail equipment, car builders look for a heavy postwar market, somewhere in the neighborhood of 100,000 cars a year for at least five years. During the past ten years, new cars going into service have averaged about 43,000 a year, but cars going out of service have averaged close to 80,000 a year during the same period. This has brought the total serviceable freight cars down from about 2,500,000 to about 1,800,000, a fact that has made the railroads' war achievements little short of miraculous.

Steel Companies Ask WLB to Reconsider Recent Wage Award

Washington

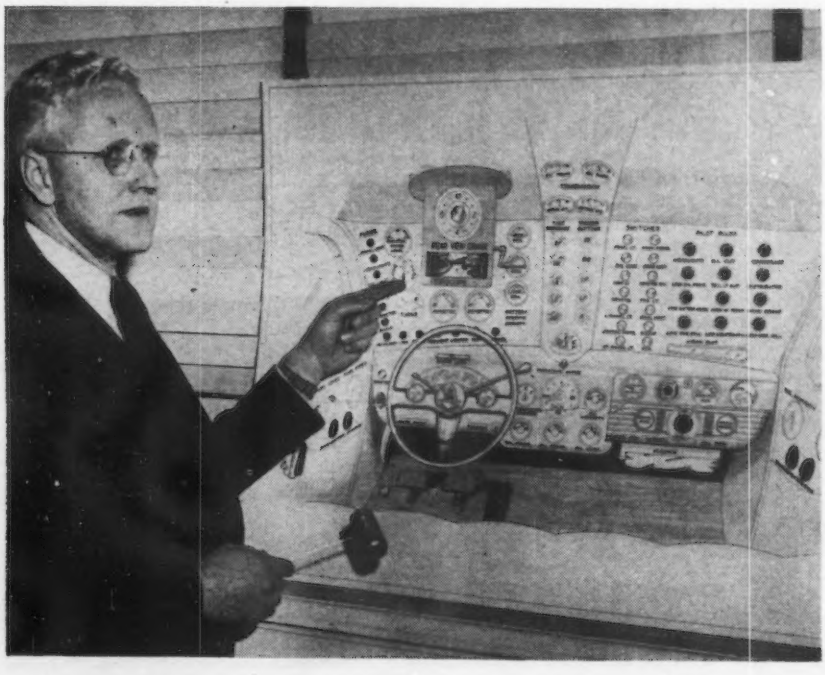
• • • **Declaring that the** War Labor Board's Order in the Steel Case violated the government's stabilization program and overlooked equity and justice in its retroactive provisions, over 70 of the companies have petitioned the board for reconsideration.

The Steel Case Research Committee, through its chairman, John A. Stephens, pointed out that certain provisions of the board's order are not now effective and will become effective only upon determination by the Office of Price Administration that the wage increases will not require changes in price ceilings or, upon approval by the Director of Economic Stabilization, Fred M. Vinson. Among the matters upon which Vinson must rule are shift differentials, vacation pay and provisions for alleged rate inequity adjustments.

"It is unfortunate," said Mr. Stephens, "that steel workers believe that the order for wage increases is now effective. Such is not the case." In view of the war situation, the companies are accepting those parts of the board's directive which are not dependent on the action of Mr. Vinson."

"The provisions establishing shift differentials and eliminating alleged wage rate inequities are, in fact, wage increases which the Board has no authority to order," Mr. Stephens said. "All of these provisions and their re-

SUPER-DUPER DASH BOARD: ***If everyone's suggestions for a dash board were incorporated in the postwar automobile, the instrument panel would look something like this—filling up all the windshield space, so that a periscope would have to be used for front vision. This hypothetical peek into the future was afforded the Society of Automotive Engineers at Detroit, by E. F. Webb of the Electrical Laboratory of Engineering Division of Chrysler Corp., providing a light note in a symposium on postwar automotive electric systems.***



troactive character, place a serious financial burden upon the companies. As the order stands, these retroactive labor costs will apply against products delivered and paid for over the last year."

Press statements of the Union asserting that the order for elimination of rate inequities means a retroactive general wage increase of 5c. an hr. were quoted by the companies in asking reconsideration of this provision.

A meeting of representatives of the steel-manufacturing subsidiaries of the U. S. Steel Corp. and of the Steelworkers Union was to have been held in Pittsburgh Dec. 14 to discuss parts of the board's directive now in effect.

Hershey Set to Send Essential Men Back To War Production

Washington

• • • **Maj. Gen. Lewis B. Hershey,** director of selective service, on Dec. 11, sent telegrams to all state directors of selective service in the continental United States as a first step to put into effect the policy of James F. Byrnes, Director of the War Mobilization and Reconversion Administration of recruiting manpower for critical war production. The Byrnes "work or fight" order tightens draft deferment regulations of men above 26 years of age, some 4,000,000 in number, most of whom are now engaged in war work. It is estimated that between 90,000 and 300,000 can be recruited by the shift of deferred workers back to necessary production from less essential work to which they have gone.

Aluminum Demand Resurges

Washington

• • • **The Aluminum Industry** Advisory Committee was informed by WPB officials at a recent meeting that resurgent war demands in the first six months of 1945 might cause a tightening in what was thought to be an easy situation in regard to aluminum. The chief difficulty, it was indicated, was a shortage of manpower in the fabricating plants, rather than in the supply of the basic metal itself. Among aluminum products, a tightening up was indicated in sheet and extruded products, WPB officials reported, while rods, bars, rivets, tubing, forgings, castings and aluminum powder were in sufficient supply.

Steel Output For November Is Down

New York

• • • **Steel production in** November totaled 7,258,534 tons of ingots and castings, it is indicated by a report released by the American Iron and Steel Institute. In October production was 7,615,553 tons, a revised figure. In November, 1943, production was 7,371,975 tons.

Part of the decline in production as compared to October was because of the shorter month of November.

Total steel production in the first eleven months of 1944 was reported at 82,199,288 tons, as against 81,581,222 tons in the corresponding period of 1943.

During November the industry operated at an average of 94.1 per cent of capacity, as against 95.6 per cent of capacity in October and 98.6 per cent in November a year ago.

An average of 1,691,966 tons of steel was produced per week in Nov.

Production of Open Hearth, Bessemer and Electric Steel Ingots and Steel for Castings

Based on Reports by Companies which in 1943 made 98.3 Per Cent of the Open Hearth, 100 Per Cent of the Bessemer and 87.9 Per Cent of the Electric Ingot and Steel for Castings Production.

Source: American Iron & Steel Institute

1944

Period	Estimated Production—All Companies: Open Hearth Net Tons*	Open Hearth Per Cent* of Capacity	Bessemer Net Tons*	Bessemer Per Cent* of Capacity	Electric Net Tons*	Electric Per Cent* of Capacity	Total Net Tons*	Total Per Cent* of Capacity	Calculated* Weekly Production all Companies (Net Tons)	Number of Weeks in Month
January	6,769,438	97.2	439,551	85.4	377,751	83.3	7,586,740	95.6	1,712,582	4.43
February	6,410,338	98.5	409,781	85.2	368,555	87.0	7,188,674	96.9	1,736,395	4.14
March	6,976,450	100.1	455,368	88.5	388,408	85.7	7,820,226	98.5	1,765,288	4.43
1st Quarter	20,156,226	98.6	1,304,700	86.4	1,134,714	85.3	22,595,640	97.0	1,738,126	13.00
April	6,768,895	100.3	437,517	87.8	362,118	82.5	7,568,530	98.5	1,764,226	4.29
May	6,860,532	98.5	436,980	85.3	380,960	84.0	7,680,472	96.8	1,733,741	4.43
June	6,452,087	95.6	418,117	83.9	347,028	79.0	7,217,232	93.9	1,682,338	4.29
2nd Quarter	20,081,514	98.1	1,294,614	85.6	1,090,106	81.9	22,466,234	96.4	1,726,844	13.01
1st 6 months	40,237,740	98.4	2,599,314	86.0	2,224,820	83.6	45,061,874	96.7	1,732,483	26.01
July	6,723,994	96.7	415,593	80.9	334,710	74.0	7,474,297	94.4	1,691,017	4.42
August	6,691,262	96.0	429,837	83.5	348,901	77.0	7,469,800	94.1	1,686,185	4.43
September	6,464,631	95.6	398,028	80.0	330,837	75.2	7,193,496	93.4	1,680,723	4.28
3rd Quarter	19,879,887	95.8	1,243,258	81.5	1,014,448	75.2	22,137,593	93.7	1,686,031	13.13
9 months	60,117,627	97.5	3,842,572	84.5	3,239,268	80.8	67,199,467	95.7	1,716,900	39.14
October	6,822,670	97.5	420,108	81.6	335,526	73.7	7,578,304	95.1	1,710,678	4.43
November	6,556,142	96.7	403,889	81.0	298,503	67.7	7,258,534	94.1	1,691,966	4.29

Note—The percentages of capacity operated are calculated on weekly capacities of 1,372,755 net tons open hearth, 116,182 net tons Bessemer and 102,350 net tons electric ingots and steel for castings, total 1,791,287 net tons: based on annual capacities as of Jan. 1, 1944, as follows: Open hearth 82,223,610 net tons, Bessemer 6,074,000 net tons, Electric 5,350,880 net tons.

* Revised January through March, 1944.

1943

Period	Estimated Production—All Companies: Open Hearth Net Tons*	Open Hearth Per Cent* of Capacity	Bessemer Net Tons*	Bessemer Per Cent* of Capacity	Electric Net Tons*	Electric Per Cent* of Capacity	Total Net Tons*	Total Per Cent* of Capacity	Calculated* Weekly Production all Companies (Net Tons)	Number of Weeks in Month
January	6,576,788	97.8	478,161	85.9	369,573	95.5	7,424,522	96.8	1,675,964	4.43
February	6,031,615	99.3	447,810	89.1	345,189	98.8	6,824,604	98.5	1,706,151	4.00
March	6,787,902	100.9	503,565	90.4	383,111	99.0	7,674,578	100.0	1,732,410	4.43
1st Quarter	19,396,295	99.3	1,429,536	88.4	1,097,873	97.7	21,923,704	98.4	1,704,798	12.86
April	6,510,824	99.9	482,478	89.5	380,401	101.5	7,373,703	99.3	1,718,812	4.29
May	6,669,703	99.1	482,424	86.6	397,564	102.7	7,549,691	98.4	1,704,219	4.43
June	6,202,889	95.2	453,663	84.1	382,801	102.1	7,039,353	94.8	1,640,875	4.29
2nd Quarter	19,383,416	98.1	1,418,565	86.8	1,160,766	102.1	21,962,747	97.5	1,688,144	13.01
1st 6 months	38,779,711	98.7	2,848,101	87.6	2,258,639	99.9	43,886,451	98.0	1,696,423	25.87
July	6,556,794	96.8	466,345	90.6	384,737	91.9	7,407,876	96.2	1,675,990	4.42
August	6,700,118	98.7	484,847	94.0	401,499	95.7	7,586,464	98.3	1,712,520	4.43
September	6,646,968	101.4	480,757	96.4	368,814	95.4	7,514,339	100.7	1,755,687	4.28
3rd Quarter	19,903,880	99.0	1,431,949	93.6	1,172,850	94.4	22,508,679	98.4	1,714,294	13.13
9 months	58,683,591	98.8	4,280,050	89.5	3,431,489	98.0	66,395,130	98.1	1,702,439	39.00
October	6,892,029	101.6	513,585	99.5	408,503	97.4	7,814,117	101.2	1,763,909	4.43
November	6,543,204	99.6	440,878	88.2	387,893	95.5	7,371,975	98.6	1,718,409	4.29
December	6,502,980	96.0	390,979	75.9	361,185	86.3	7,255,144	94.2	1,641,435	4.42
4th Quarter	19,938,213	99.1	1,345,442	87.9	1,157,581	93.1	22,441,236	98.0	1,707,857	13.14
2nd 6 months	39,842,093	99.0	2,777,391	90.8	2,330,431	93.7	44,949,915	98.2	1,711,074	26.27
Total	78,621,804	98.9	5,625,492	89.1	4,589,070	96.7	88,836,366	98.1	1,703,804	52.14

Note—The percentages of capacity operated in the first 6 months are calculated on weekly capacities of 1,518,621 net tons open hearth, 125,681 net tons Bessemer and 87,360 net tons electric ingots and steel for castings, total 1,731,662 net tons: based on annual capacities as of January 1, 1943, as follows: Open hearth 79,180,860 net tons, Bessemer 6,553,000 net tons, electric 4,554,980 net tons. Beginning July 1, 1943, the percentages of capacity operated are calculated on weekly capacities of 1,531,789 net tons open hearth, 116,494 net tons Bessemer and 94,667 net tons electric ingots and steel for castings, total 1,742,950 net tons; based on annual capacities as follows: Open hearth 79,867,450 net tons, Bessemer 6,074,000 net tons, Electric 4,935,960 net tons.

* Revised January through December, 1943.

Industrial Briefs . . .

• GOVERNMENT SHORTAGE—Reconstruction Finance Corp., Chicago, has arranged for the use of a 138-acre tract near Hammond, Ind., to be used for storage of surplus government owned machine tools. Approximately 65 acres will be prepared for use immediately. As in other storage lots, sectional metal storage sheds will be erected. This is the only storage for such use that has yet been arranged in this area.

• POSTWAR TRAVELING — Hercules Powder Co., Wilmington, Del., has purchased a UC45F twin-engine, low-winged Beechcraft passenger monoplane for the use of its executives traveling on war work.

• ALLIGATOR OUTPUT — The 1000th Alligator rolled off the Graham-Paige Motors Corp.'s assembly lines in Detroit recently, marking a milestone in the history of the famous amphibious tank. The company's subsidiary in Warren, Ohio, plans to produce hull assemblies for the tanks, in addition to its production of complete Beaver landing craft.

• EXPORT PROGRAM—Yale & Towne Mfg. Co., New York, has taken steps to expand its export business further by the establishment of export sales departments and managers in the Stamford and Philadelphia divisions. Similar plans are now being developed to increase the export sales of the Automatic Transportation Division, in Chicago.

• INSTALLATIONS — American Manganese Steel Division of American Brake Shoe Co. is spending more than $75,000,000 for alterations to buildings and purchase of new equipment to increase its capacity for the manufacture of extruded coated welding electrodes.

• NO PROFITS—Jones & Laughlin Steel Corp. has announced that renegotiation of the business of the corporation and its subsidiaries for the year ended Dec. 31, 1943, has been completed and it has been determined that no excessive profits have been realized for that year.

• NEIGHBORLY DEAL—A portion of the shipping and inspection department of the DPC aluminum rolling mill operated by Alcoa, near LaGrange, Ill., has been leased to its neighbor, Electro-Motive Corp.

• PURCHASES BUILDINGS — Joseph M. Franklin & Associates have purchased the 30 - odd buildings and land of the inactive Walworth Co., Attalla, Ala., and will start production of cast iron pipe and fittings under the corporate name of Attalla Pipe & Foundry Co.

• ACQUISITION—Spun Steel Corp., Canton, Ohio, has purchased and will occupy the Canton plant of the Milcor Steel Corp., which recently purchased control of the J. M. & L. A. Osborn Co., Cleveland, and is expected to move into that city.

• ORGANIZES FIRM — Keaton Mfg. Co., Milwaukee, has been organized to manufacture automatic screw machinery and other lines.

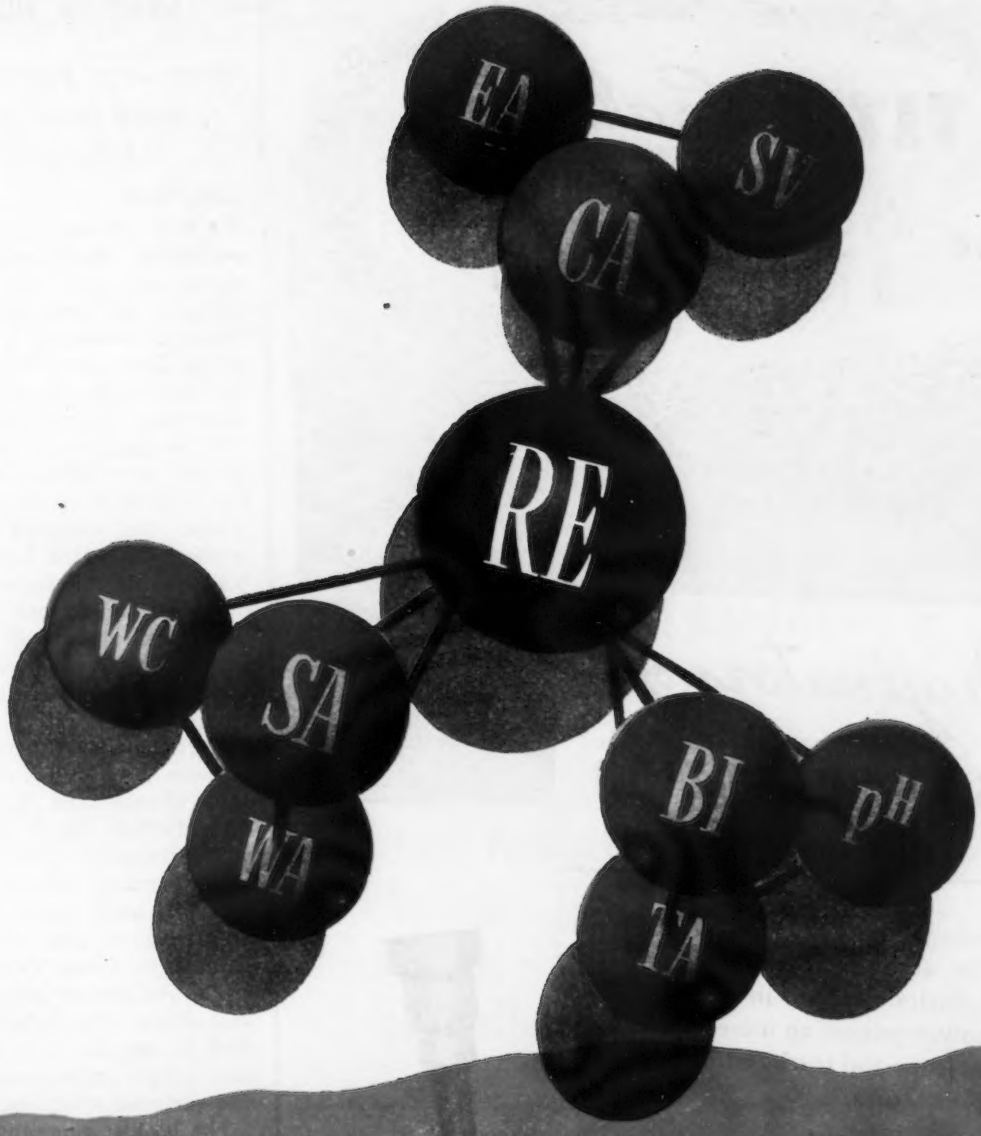
• FORMS LIBRARY — Formation of a new and important library collection on military aeronautics has been announced by the Air Technical Service Command, Wright Field, Ohio, in conjunction with an invitation from the Command's Technical Data laboratory for public contributions of books, documents, articles and other items of technical and historical interest in the field of military aviation.

• CANADIAN ADDITION—Chrysler Corp. of Canada, Ltd., has announced a large addition to its manufacturing plant No. 3 at Tecumseh and Drouillard Roads, Windsor. The addition will increase the plant approximately one-third more than its present size. Contract for structural steel fabrication and erection has been awarded to Canadian Bridge Co., Ltd., Windsor. The general contract for the balance of the construction has been awarded to another Windsor firm, Dinsmore-McIntire, Ltd.

SHIPMENTS OF STEEL PRODUCTS CLASSIFIED BY CONSUMING INDUSTRIES

(Net Tons)

Source: American Iron and Steel Inst.	NET TOTAL THIRD QUAR. 1944
1. Steel Converting and Processing Industries	
(a) Wire drawers and wire product mfrs.	161,095
(b) Bolt, nut and rivet manufacturers	288,046
(c) Forging manufacturers	
(1) Automotive and Aircraft	133,454
(2) All other	377,567
(d) All other steel plants and foundries	478,757
Total	1,438,919
2. Jobbers, Dealers and Distributors	
(a) Oil and natural gas industry	156,895
(b) All other	1,853,667
Total	2,010,562
3. Construction Industry	
(a) Public (Municipal, State, National)	18,582
(b) Highways	45,173
(c) Railways	27,300
(d) Automotive and Aircraft	25,006
(e) Utilities	79,661
(f) Bldg. trim, accessories and builders' hdwe.	103,980
(g) All other	888,168
Total	1,187,870
4. Shipbuilding Industry	2,321,457
5. Pressing, Forming and Stamping Industry	
(a) Metal furniture and office equipment	37,696
(b) Hardware and household equipment	99,266
(c) Automotive	312,030
(d) All other	291,571
Total	740,563
6. Container Industry	
(a) Oil and natural gas industry	80,760
(b) All other	849,753
Total	930,513
7. Agricultural, Incl. Impl. and Equip. Mfrs.	283,306
8. Machinery and Tools	
(a) Machinery and tools, not incl. elect. equip.	447,840
(b) Electrical machinery and equipment	204,926
Total	652,766
9. Automotive and Aircraft Industry	469,607
10. Railroad Industry	
(a) All railroads	937,294
(b) Car and loco. builders and parts mfrs.	399,884
Total	1,337,178
11. Oil, Natural Gas and Mining Industry	
(a) Oil and natural gas, incl. pipe lines	305,300
(b) Mining, quarrying and lumbering	49,271
Total	354,571
12. Miscellaneous Industries and Export	3,277,308
13. Total (Items 1 to 12)	15,004,620



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Correctly cleaning metal is no simple operation... these elements must go into action...

Wetting Action *(WA)* must lower surface and interfacial tensions and allow the cleaning solution to penetrate to surface of the base. Emulsifying Action *(EA)* must disperse grease and oil as tiny globules, and by suspension prevent redeposition. Saponifying Value *(SV)* must convert organic fats and oils into soluble soaps, and Solvent Action *(SA)* put soils into solution. Colloidal Activity *(CA)* must disperse solid soils into minute particles which may then be easily removed. Water Conditioning *(WC)* removes or controls the elements which cause water hardness.

Correct Buffer Index *(BI)* assures ability to absorb either alkaline or acid soil, thus prolonging efficiency of the solution. Proper *pH* assures the correct measure of energy of alkalinity and Total Alkalinity *(TA)* must supply maximum active cleaning energy.

In formulating a cleaning compound, therefore, it is obvious that no one factor is a magic key to all problems. The answer is in determining the relative value of *all* these factors as they apply to *your* problem.

Putting these factors into correct balance is a responsibility you can entrust to Turco chemists —a responsibility for which their two decades of Research and Experience *(RE)* have well qualified them. *Take your problem to Turco.*

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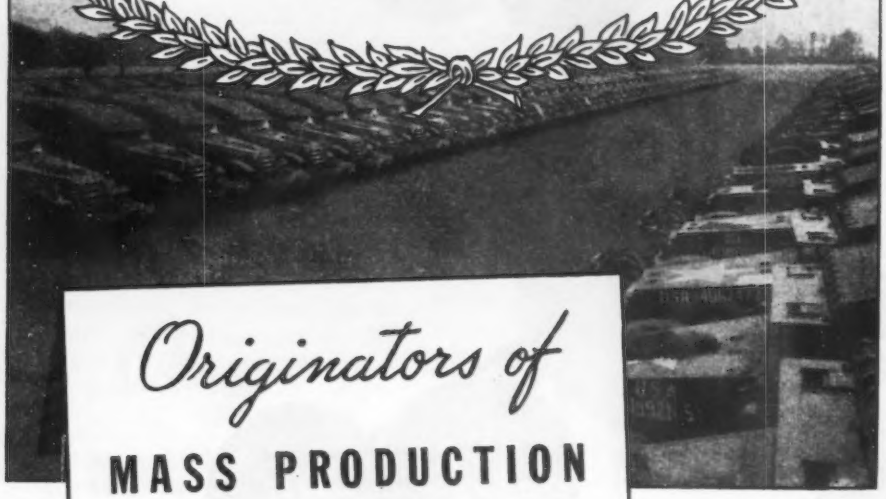

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Gray Iron Founders Issue Booklet Which Interprets MPR 244

Cleveland

• • • To interpret and clarify the regulation establishing maximum prices for gray iron castings, the industry advisory committee to the OPA has issued, with the cooperation of the Gray Iron Founders' Society, a special booklet titled "The ABC's of Maximum Price Regulation No. 244."

In a question-and-answer analysis of the regulation's major provisions, the booklet discusses, in simple language, the coverage of the order, methods by which the seller may determine his maximum prices, short order pricing, formula price recomputation, calculation of overtime addition, sellers' records and reports, and applications for amendment, adjustment or exception.

Particularly informative are the answers to questions concerning measures of relief and adjustable pricing. Four factors, the booklet points out, will determine whether a foundry, seeking relief, should apply on the basis of individual castings, groups of castings or total sales. These are listed as the foundry's specific requirements, the availability of or burden of assembling the information to be filed in support of a relief application, OPA's policy in granting relief, and customer relations.

The booklet reproduces the regulation, including amendments 8 and 9 issued in June and September, 1944, respectively. It also contains, for the convenience and study of those who propose to apply for relief, the new OPA price relief forms and a reproduction of "Supplementary Order 28" which describes the procedure for filing a price relief request on the basis of a wage or salary increase requiring NWLB approval.

"While the text has not been officially approved by the Office of Price Administration, it has been read by members of the OPA staff and their suggestions have been incorporated," the booklet's foreword states.

Cleveland headquarters of the society has distributed the new booklet to all producers. While it was prepared primarily for producer and seller, the booklet should also prove of interest, the committee believes, to castings buyers and will be made available to them.

H. L. Edinger, president, Barnett Foundry & Machine Co., Irvington, N. J., and vice president of the society, is chairman of OPA's gray iron

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castings industry advisory committee. Other members are Walter Chadwick, Davenport, Iowa; C. R. Culling, St. Louis; C. C. Ford, Wichita; R. E. Kucher, Seattle; C. B. Magrath and R. D. Phelps, Chicago; F. H. Rayfield, Atlanta; A. B. Root, Boston; S. D. Russell, Oakland, Calif., and W. S. Thomas, Philadelphia.

Great Britain's War Support for Allies Exceeds $4 Billion

Washington

• • • **Britain's second** report on mutual aid, reverse lend-lease, issued as a government White Paper recently, revealed that the value of goods, services and capital facilities provided by the United Kingdom to its Allies up to June 30, 1944, exceeded $4,250,000,000. Of this total, reciprocal aid to the United States amounted to well over 50 per cent—$2,437,000,000.

Next to the United States, Russia was the principal recipient of British mutual aid. The Soviet Union's share amounted to over one billion dollars. Other beneficiaries included France, China, Poland, Greece and Czechoslovakia, while strategic assistance was also given to friendly "neutrals" such as Turkey and Portugal.

Material aid was also furnished to partisan and patriot forces fighting the Germans inside occupied Europe, the report stated, but no figures were available for these supplies. Among those listed were Czechoslovaks, Norwegians, Poles and Danes in addition to the French Forces of the Interior and patriots of other liberated or partly liberated countries.

Since Britain's last report on reverse lend-lease issued a year ago and covering the period up to June 30, 1943, goods and services afforded the United States in the United Kingdom amounted to over $900,000,000 as compared with $450,000,000 in the preceding account.

An additional $54,000,000 in mutual aid to America was accounted for in food and raw materials, including 38,366 tons of rubber, 55,849 tons of cocoa and 10,206 tons of tea, which were shipped to the U. S. during the past year, while the value of other supplies, including munitions and aeronautical equipment transferred or exported to this country, totaled over $100,000,000. The cumulative figure for capital facilities afforded U. S. forces in the United Kingdom, British colonies, and overseas war theaters amounted to $700,000,000.

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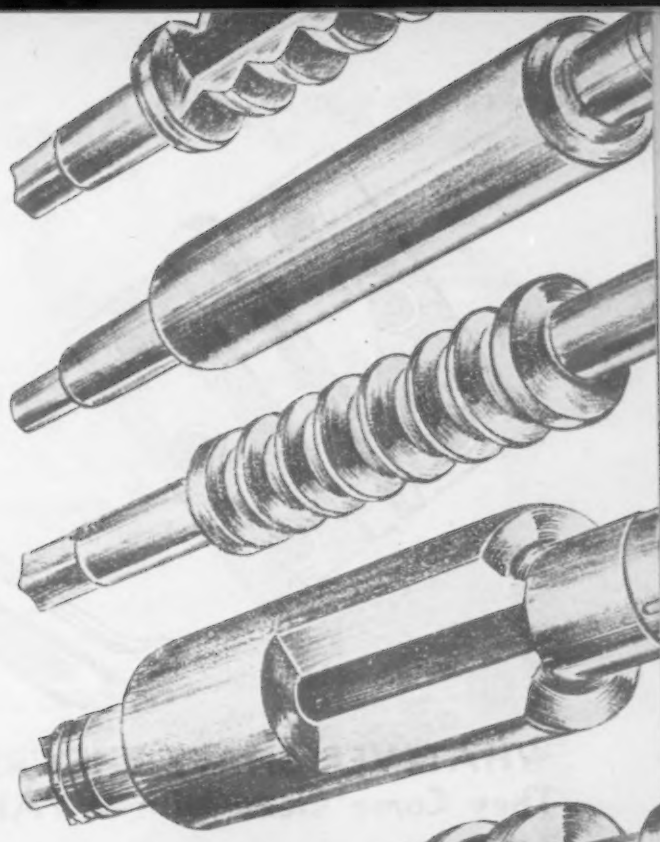

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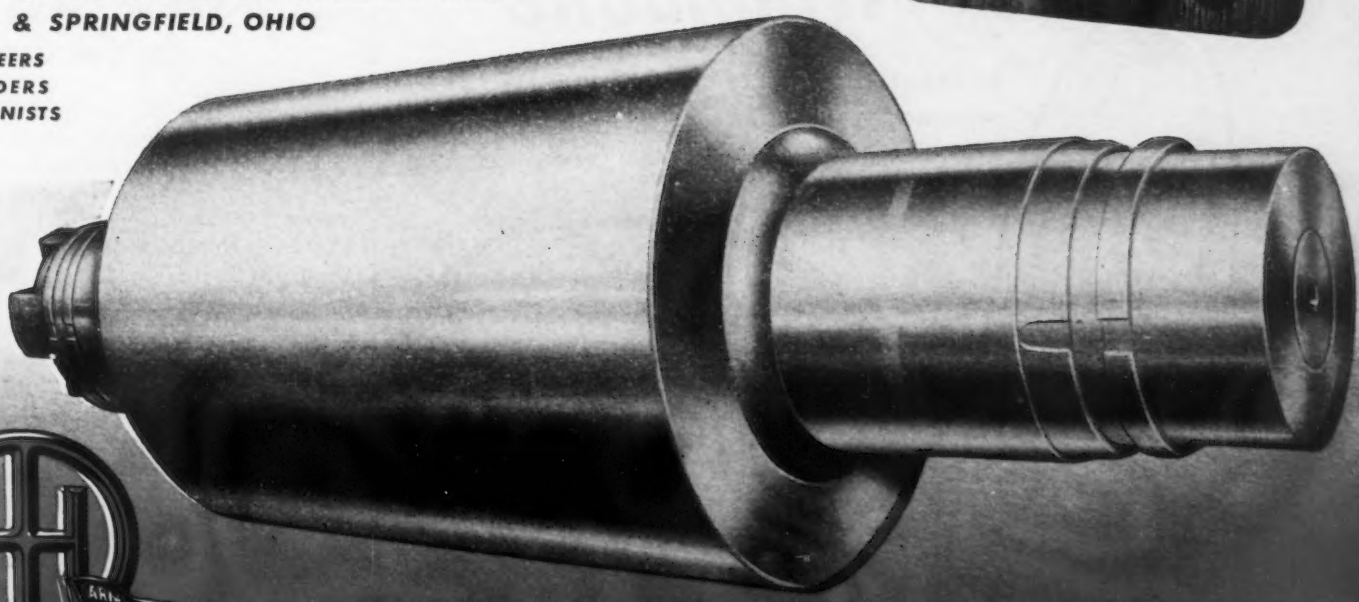
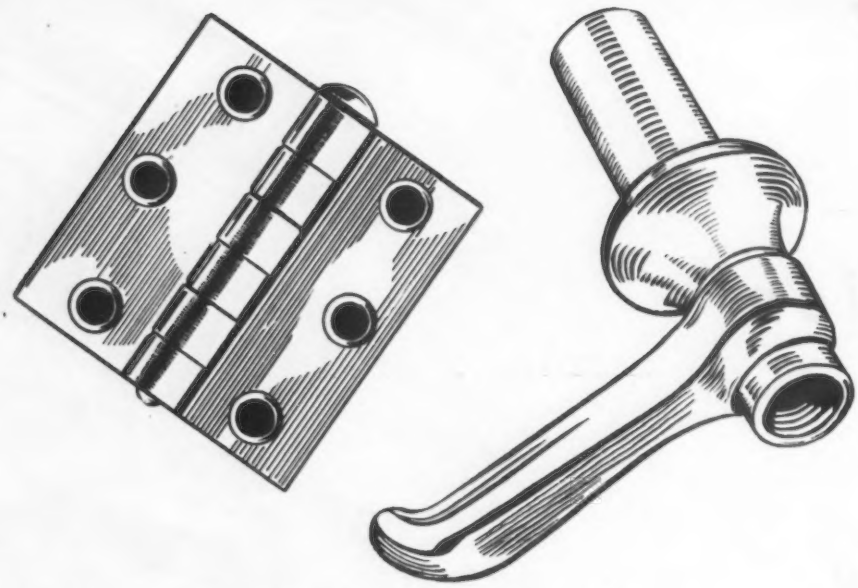


Free enterprise is the only way to constantly higher American living standards



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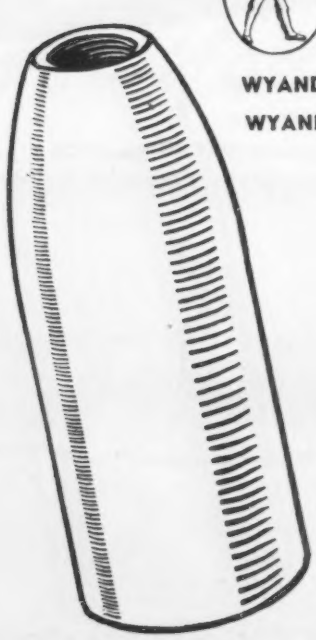

Western Engineers' 75th Anniversary To Be In December

Chicago

• • • **Celebration of the** 75th anniversary of the founding of the Western Society of Engineers was held Dec. 5, at the Hotel Sherman, Chicago.

The society was founded in 1869, making it the third oldest engineering society in the United States. Purpose of the organization is "the advancement of theory and practice of engineering, the improvement of the status of engineering practice as a profession and maintenance of high professional standards."

The society library includes 23,000 volumes and pamphlets carefully indexed, and current issues of over 200 trade and technical publications. The organization administers or participates in four major honorary awards having as their purpose the recognition of engineering accomplishments. These are the Octave Chanute Medal, the Washington Award, the Charles Ellet Award and the Alfred Noble prize.

At the anniversary meeting, honorary memberships were granted to Daniel Webster Mead, construction engineer of Madison, Wis., and George Terry Horton, president of Chicago Bridge & Iron Works. Frank F. Fowle was toastmaster, and Col. Robert F. McCormick, publisher of the Chicago Tribune, principal speaker.

189,539 Estimated Jobless in Ohio's Postwar Industry

Cleveland

• • • **Employers having on** their payrolls almost 50 per cent of the 2,000,000 men and women covered by Ohio's unemployment compensation fund anticipate layoffs at the end of the European war to aggregate 189,539. Made public this week by the State Bureau of Unemployment Compensation, the figure indicated that layoffs would equal only 40 per cent of the war-created increase in Ohio employment. This estimate was obtained by the bureau in a poll of 640 establishments whose combined employment constitutes about 70 per cent of all persons engaged in manufacturing and mining in Ohio.

Significantly, the employers indicated that they expected 55,933 of the

UNIFORM HARDNESS *Without* RE-QUENCHES

SUN QUENCHING OIL

hardens steel uniformly . . . stops re-heats . . . saves fuel

Metal working plants that have difficulties with quenching and hardening operations may find the right answer to their problems by following the experience of one manufacturer who eliminated troublesome quenching.

Hardening of steel forgings was poor, uneven, due to oil thickening. Costly re-heats and re-quenches were necessary to correct this condition, wasting time and fuel. Looking for a solution, they called a Sun Oil Engineer who recommended a switch to Sun Quenching Oil, Light, and troubles vanished.

Uniform hardening was obtained . . . re-quenching was unnecessary . . . costs were cut. The elimination of re-heats saved time, labor, fuel. And Sun Oil remained uniform over longer periods of time. For more than five years all these advantages have been steadily maintained at this metal working plant—a fine record for Sun Quenching Oil!

Call a Sun Oil Engineer for complete service when similar problems confront your plant, whether they be on metal cutting oils, processing oils, or general lubrication. There's a Sun Product for every industrial need. As an extra service to industry, Sun offers its handy booklet "How to Get the Most Out of Lubricants." A free copy is yours by writing . . .

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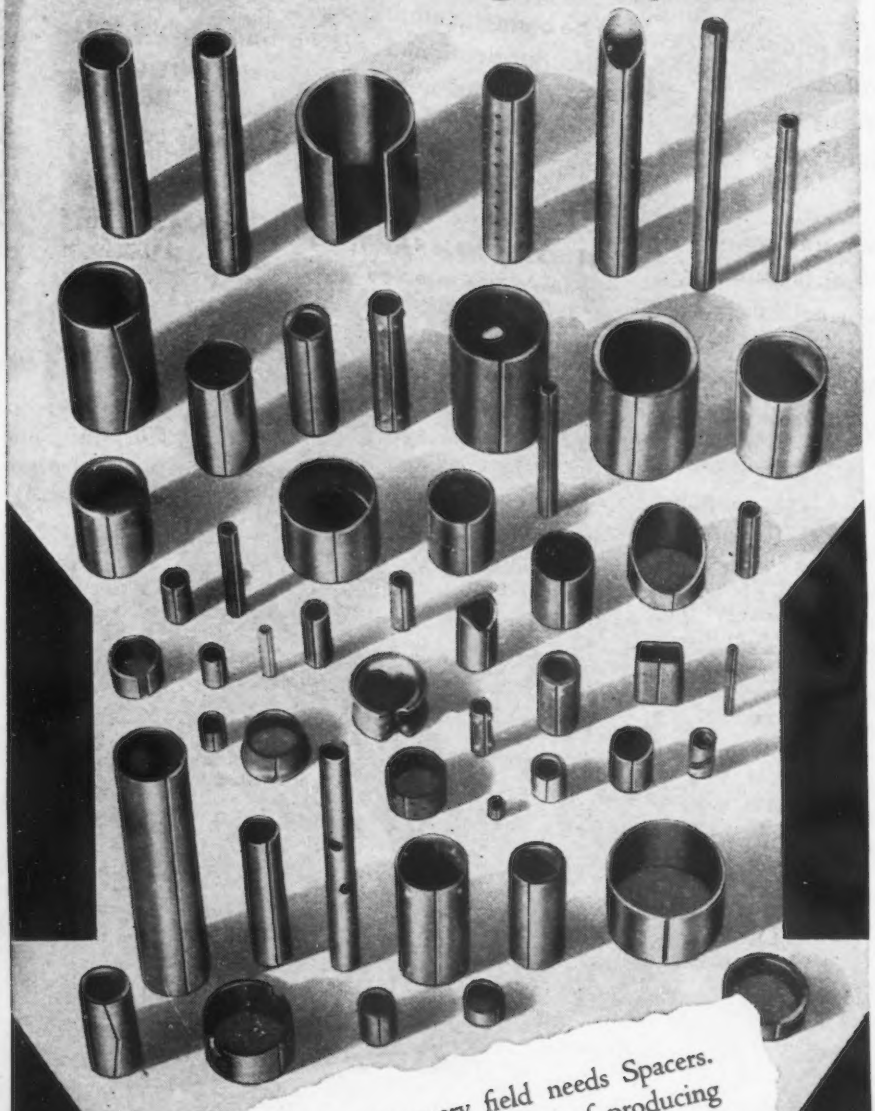
Your Products Can Probably be Improved with Wagner Spacers



Nearly every product in every field needs Spacers. We have perfected a new method of producing them, on specially designed automatic machines, in any metal and in a large variety of sizes and shapes. Every day manufacturers find new uses for Wagner Rolled Butted-Joint Spacers and Bushings. They speed up production and are economical to use. Investigate the use of Wagner Spacers in your products. Write today.

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Since 1899 producers of Metal Specialties, Continuous Hinges, Hinges and Hardware.

total layoffs to be temporary, and that a number said they anticipated increased rather than decreased employment after the war. Companies looking forward to postwar personnel expansion anticipated hiring 28,540 new employees.

In the eight larger Ohio cities, Cleveland, Cincinnati, Youngstown, Columbus, Akron, Toledo, Dayton, and Canton, key employers estimated that in the period of 60 or 90 days immediately following the end of the war with Germany, they would lay off approximately 137,057 workers.

In the 42 smaller areas surveyed, comprising the remainder of the state, employers indicated that their layoffs during the same period would approximate 52,482. And if the layoffs anticipated by the 30 per cent of employers in manufacturing and mining not covered by the survey remain in this proportion, it would mean that contract cancellation and cutbacks after V-E Day would be likely to affect 270,770 Ohioans, or about 40 per cent of the 660,000 increases in employment that took place in Ohio between March, 1940, and the peak of war employment late last fall.

Erie, Pa., War Contracts Total $412,425,000

Erie, Pa.

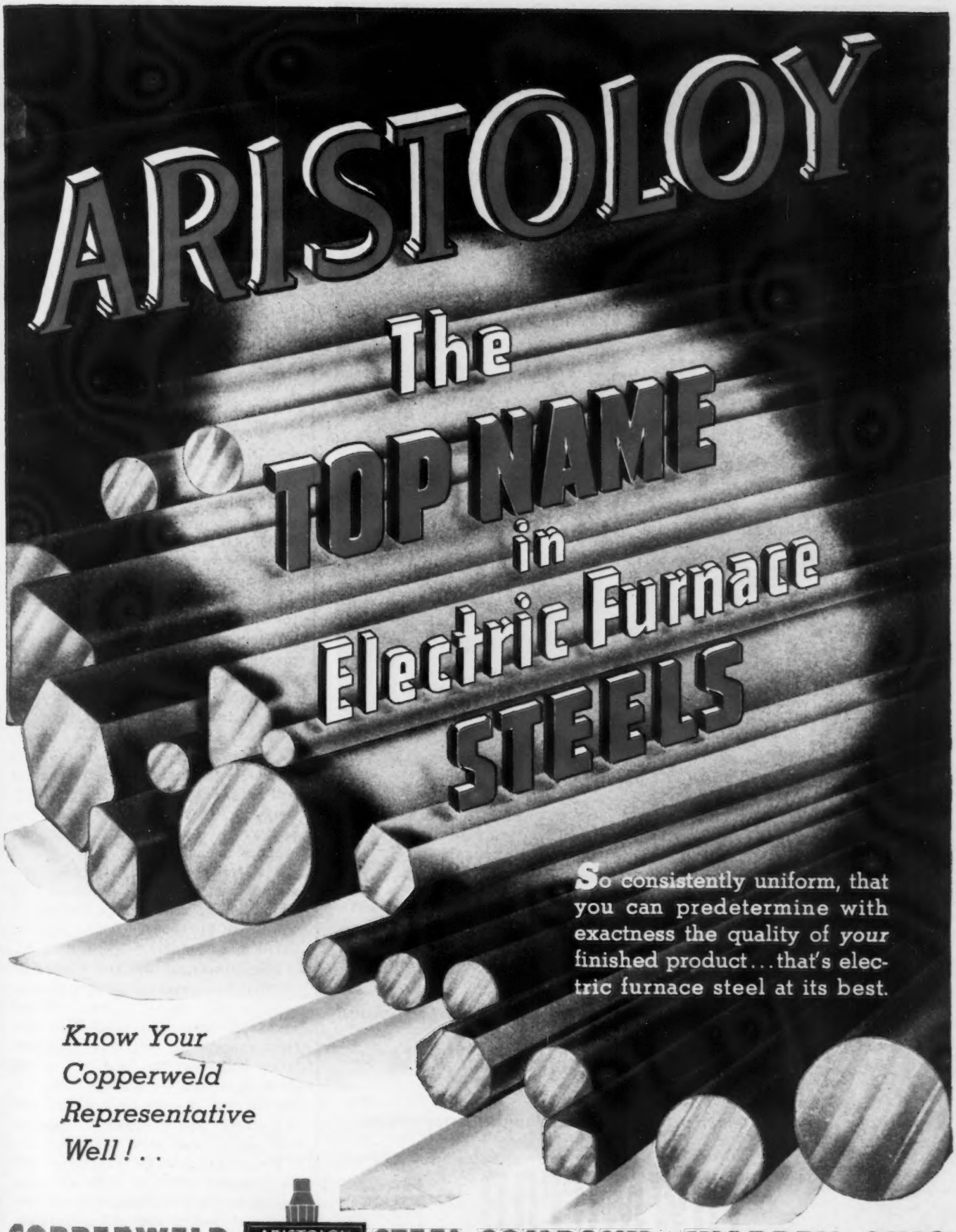
• • • **Major prime war supply contracts and facilities contracts awarded in the Erie industrial area, which covers Erie County, since the beginning of the war through September 1944, have amounted to more than $412,425,000, Ralph W. DeLancey, WPB district manager, reported.**

This figure compares with a state total of $12,420,785,000 and a national total of $204,908,011,000. Mr. DeLancey pointed out that changing military demands and manpower problems have caused several important programs to fall behind schedule, and that renewed effort is necessary to get war production up to maximum.

The figures are as follows:

Supply contracts — aircraft, $10,292,000; ships, $69,093,000; ordnance, $168,190,000; all other, $106,570,000. Facilities — industrial, $58,280,000. Total—$412,520,000.

The figures shown for supply contracts are the totals of individual contracts awarded by the Army, Navy, Maritime Commission, Treasury Procurement Division and foreign purchasing missions reported to the WPB since June 1940. Defense aid awards are included — treasury contracts include only such awards.



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STRAIGHT—GAS POWERED INDUSTRIAL TRUCKS EXCLUSIVELY—SINCE 1919

Frazer Prophesies 10-Billion Dollar Automobile Years

Oklahoma City

• • • **A prediction** that the automobile dealers of America will enjoy a series of "ten-billion dollar years" after the war, was advanced here recently by Joseph W. Frazer, chairman of Graham-Paige Motors Corp.

Speaking to the convention of the Oklahoma Automobile Dealers Association at the Skirvin Hotel, Frazer asserted that dealers will enjoy "the biggest sellers' market in history when peace comes, eclipsing the buying rush which gave retailers a $7,800,000,000 business in 1941."

The auto executive said his prophesy is based on the belief that the industry will produce more than 6,500,000 units in its first year of unrestricted production, and possibly 30,000,000 cars in the first five years after the war.

Frazer gave the following analysis of the "tremendous pent-up demand for automobiles:

"It is estimated that there are approximately 6,500,000 one-time car owners in America without automobiles and 1,000,000 former truck users without trucks. In addition, there are 8,000,000 drivers who are about ready to junk their cars, since they are more than 7½ years old. Therefore, there will be an immediaae market for 15,000,000 automobiles and trucks in this country as soon as the industry can produce them.

"The tremendous demand for new motor vehicles," he explained, "is supported by the savings backlog of more than $100,000,000,000 now in the hands of consumers."

Frazer warned dealers that after the first two years of production competition will begin to be "hot and heavy," because new companies with fresh concepts of individual transportation will enter the field and, on the strength of the tremendous sales potential, will be able to build up new and strong dealer bodies to compete with the old and large companies.

The Graham-Paige executive said his company plans to build an automobile which will "depart from conventional design and utilize plastics, light metals and recent engineering developments—a completely new car from the ground up."

The new automobile, he explained, will probably be produced in two body models, and will sell in the moderate price class; its six-cylinder engine

AN *Improved* SIZE 4 STARTER WITH FIVE NEW FEATURES

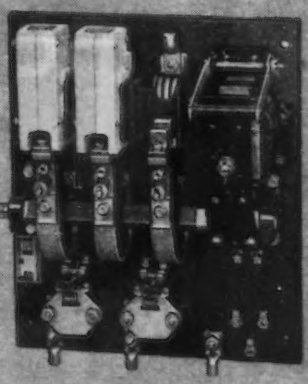
CLASS 8536 · TYPE VG-2

----SMALLER-QUIETER-----

1. Improved blow-out coils have fewer turns and are wound with heavier copper—assuring less heating effect, and efficient interruption of stalled rotor currents for electric motors up to 100 horsepower.
2. New and larger magnet of modified **"E"** type construction gives added efficiency.
3. Self-aligning, floating armature eliminates vibration noise—reduces heating and magnet wear.
4. New shading coil affords exceptional mechanical strength. This coil is held in place by the magnet coil in such a manner as to prevent its falling out. Use of heavy brass ribbon makes shading coil virtually unbreakable.
5. Narrower panel saves space and flat door cabinet permits gang mounting.

• • •

This greatly improved Type V device is available in a complete range of enclosures for all Size 4 starter applications, including reversing, combination, multi-speed, reduced voltage, etc. Call in or write your nearest Square D Field Engineer for complete information.



Open type starter panel with one arc chute removed to reveal contacts and blowout coil.

Side view of panel shows "E" type magnet, floating armature and new shading coil.

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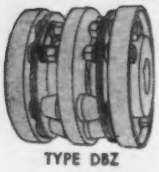
Flexible COUPLINGS
FOR *any* SPEED OR SERVICE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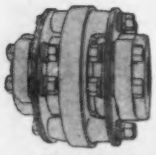
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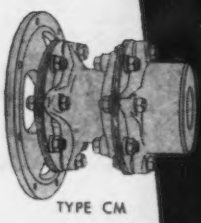
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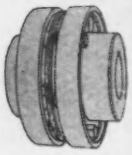
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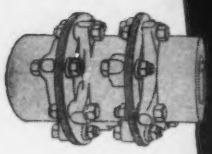
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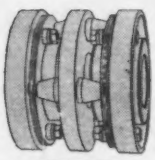
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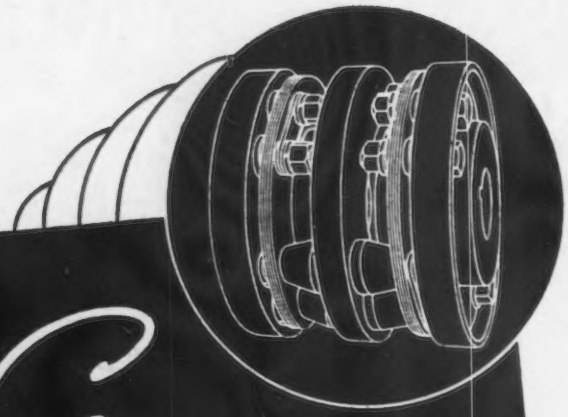


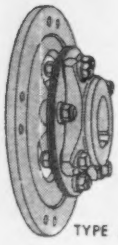
Eliminate

BACKLASH, FRICTION, WEAR AND CROSS-PULL

.....the 4 destructive evils found in all other types and makes of couplings.

NO BACKLASH
NO WEAR
NO LUBRICATION
NO THRUST
FREE END FLOAT

These are the five essential features of Thomas Flexible Couplings that insure a permanent care-free installation.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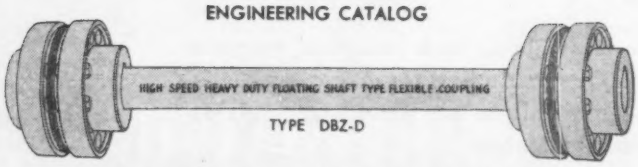
WRITE FOR COMPLETE ENGINEERING CATALOG



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THE THOMAS PRINCIPLE ELIMINATES CHAINS, SPUR GEARS and other VIBRATING MAKESHIFTS

THOMAS FLEXIBLE COUPLING CO.
WARREN, PENNSYLVANIA

will weigh considerably less than prewar engines of the same horsepower. The car will make extensive use of secondary aluminum, but the basic portion of the body will be made of steel.

Frazer said his company's postwar automobile will be a full-sized model, and not a miniature car, such as those popular in Europe before the present conflict. It will be designed to park and handle easily and to appeal to women, "who influence the buying of a vast majority of automobiles."

Manufacturers Of Cutting Tools Hold No. 1 Annual Meeting

Detroit

• • • **Completing the first year** of its existence, the Cutting Tool Manufacturers Association at its first annual meeting at the Fort Shelby Hotel in Detroit, reelected eight former directors while adding four new directors to the list.

Among those re-elected were W. G. Robbins, President, Carboloy Co., Inc.; Oscar L. Bard, President, Michigan Tool Co.; R. G. Michell, President, Eclipse Counterbore Co.; and George L. Buffington, Supt. of Estimating & Process Engineering, Ex-Cell-O Corp.; all elected for three-year terms. E. A. Goddard, Vice President, Goddard and Goddard, was re-elected for a two-year term, while Norman Lawton, Partner, Star Cutter Co.; R. M. Severance, President, Severance Industries, Inc., Saginaw; and R. H. Wolfe, President, Arrow Tool and Reamer Co. were re-elected for one-year terms.

New directors include G. W. Frick, Manager, Firthite Division, Firth-Sterling Steel Co., McKeesport, Pa.; Emil Gairing, President, Gairing Tool Company and G. E. Sheldrick, Sr., President, Midwest Tool and Mfg. Co., elected to two-year terms; and D. E. Van Deusen, Kelly Reamer Co., Cleveland, Ohio, elected for a one-year term.

Definite action to expand the Association's membership was approved at the annual meeting, calling for expanding the membership to take in groups of cutting tool manufacturers first in Illinois, Wisconsin, Ohio, Indiana and Pennsylvania in addition to Michigan. Membership is also being opened up to companies in other states. Several companies outside of the state of Michigan have already become members of the organization.

ORIGINAL DRAWING AND SKETCHES BY ORISON MACPHERSON

SAFETY OBLIGATION

To safeguard 600,000 employes while at work, is an obligation of the steel industry that is inflexibly fulfilled throughout the war period of all-time high production of steel for our fighting men, as well as in time of peace.

Steel is rated safest heavy industry from the standpoint of frequency of accidents by the National Safety Council. In its compilation of accident experience of all industries, both large and small, the frequency of accidents in the manufacture of iron and steel stands third lowest in a list of 37 industries, surpassed only by the communications and electrical equipment industries, which are not rated "heavy" industries.

Safer at work than off the job are the men and women working in the great steel plants of this country. National Safety Council figures indicate proportionately more accidents, even fatals, happen in dwellings, on streets and highways than in industry.

Steel accidents controlled. The steel industry was prepared to do an outstanding job in controlling accidents right through the present years of enormous, world-beating production of iron and steel to help win the war and win it in a hurry. According to the National Safety Council, in 1926 the steel industry averaged about 20 lost-time injuries per million man-hours worked. This accident rate was reduced during subsequent years and under the adverse conditions of war now amounts to only 7.4 per million man-hours.

Establishment of safety departments headed by experienced safety engineers, of safety classes among workers, and the constant preaching of "safety first," plus rigid and intelligent observance of safety rules by workers account for this magnificent record of the steel industry in safeguarding its hundreds of thousands of employes—even in war time.

1st steel safety department in U. S. was organized in 1892 at Joliet works of Illinois Steel Company (now part of Carnegie-Illinois Steel Corporation, U. S. Steel subsidiary). First safety order called for inspection of engine fly-wheels.

1st full-time safety engineer in steel industry was employed by Jones & Laughlin 34 years ago, and became one of the founders of the National Safety Council.

Medieval safety clothing for iron workers, described by Georgius Agricola in his *De Re Metallica* (pub. about 1550) included eye-hole hoods covering entire heads of forge or furnace workmen, leggings and long gloves, as protection from flying fragments broken off hard iron ore bodies by hammers.

Safety underfoot is provided by new, improved multi-purpose "Jal-Tread" checker floor plate. Easy to install, weld, bend. Full description in Jones & Laughlin booklet.

Conveyors handle a wide variety of commodities—parts, packages, units, cartons, cans, bottles, barrels, bundles, drums, boxes. Available in light, average, or heavy-duty types for portable or stationary use, in a wide variety of sizes, styles, and lengths . . . all built by Standard. They give you substantial savings in time and money. Engineers say that material handling constitutes about 22% of manpower cost . . . cut handling costs and you cut production costs.

Standard Conveyor Company has the experience and facilities to recommend and furnish the right type of conveyor for your particular needs. Write for catalog IA-124 "Conveyors by Standard" — a reference book that will prove very useful to you.

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Commerce Association Executive Calls For Surplus Act Revision

Chicago

• • • Grave danger of a national public scandal exists unless improved methods are found for dealing with disposal of surplus war goods, Leverett S. Lyon, chief executive officer of the Chicago Association of Commerce, declared here recently.

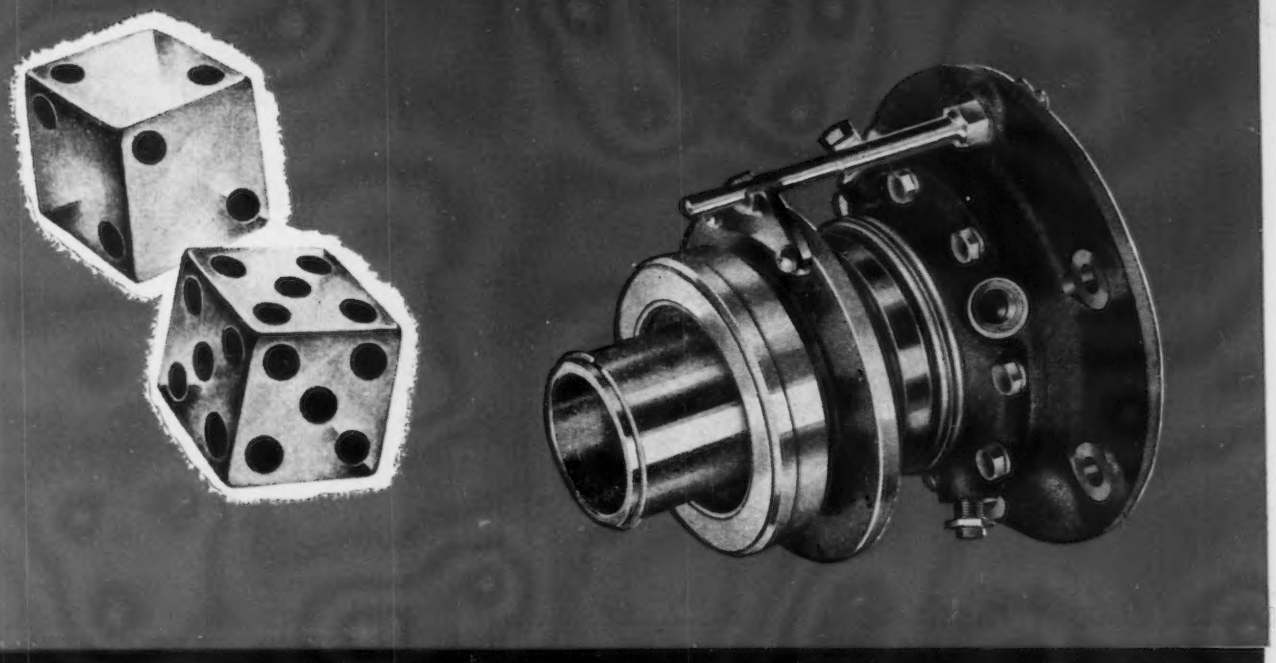
Amendments to the Surplus Property Act of 1944 are necessary to prevent such a scandal and to provide effective surplus disposal, he declared. The law now makes possible, under some circumstances, an outright gift of surplus property to states, counties, cities and other political units throughout the country and to charitable institutions, he pointed out.

Some of the provisions of the law also appear in outright conflict with others, Mr. Lyon continued. "Section 16," he said, "gives war veterans preference in the purchase of surplus; Section 17 gives farmers and farm cooperatives preference, and Section 18 appears to give small business preference. It would be interesting to see how a conflict over a truck, for example, between a veteran, a farmer and a small businessman would be resolved."

The magnitude of the problem involved in surplus disposal and the significance of the course the country adopts will have to business cannot be over-estimated, Mr. Lyon declared. "How the task is accomplished is of major importance to every businessman now and will have an effect which will be felt for many years after the war. The quantities of war surplus will be tremendous. Some estimates place the cost value of this material as high as $103,000,000,000. We are hardly yet aware of what such a large quantity of goods means. We do know, however, that if it does amount to $103,000,000,000 it will be equal to a whole year's output of goods and services in some prewar years that at the time were considered periods of high production and prosperity."

In discussing other problems which will face the country in shifting over to peace, Mr. Lyon predicted that business will find adequate extra working capital available to meet its needs during the period when war production is being terminated by contract cancellations and when the necessary readjustments are being made for peacetime production.

NEW PESCO HYDROLEASE



. . a natural any way you look at it

There are many jobs in industry that Pressurized Power by PESCO is just naturally better-fitted to perform.

This is one of them—actuating heavy clutches . . . for industrial power machinery, buses, trucks and heavy motor vehicles.

The *Hydrolease* is one of the new PESCO hydraulic products now made available to industry. It is a compact, precision hydraulic clutch actuator. When installed in the clutches of your machines it eliminates a large number of mechanical parts and points of lubrication. It substantially reduces clutch wear and tear and saves in maintenance costs.

The smooth, positive action of the *Hydrolease*—a distinctive feature of applied hydraulics—engages and disengages a clutch with new ease and more accurate control. It keeps the clutch in constant adjustment.

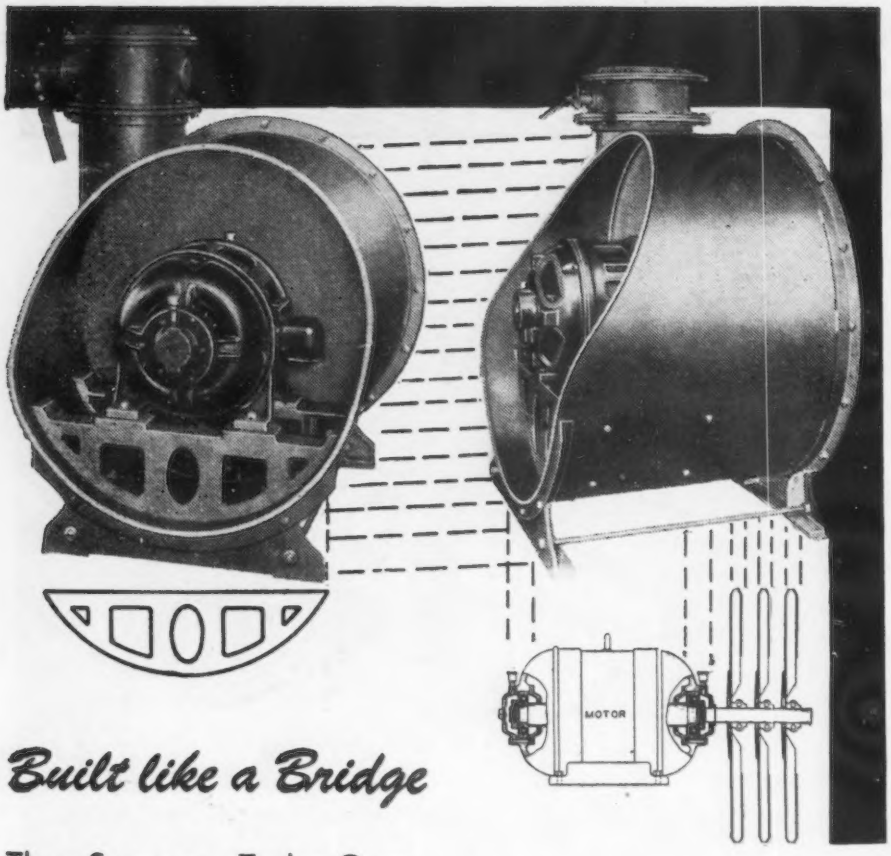
It will pay you to get complete facts about this new PESCO product. Write for the *Hydrolease* Folder to PESCO Products Company, Industry Service R, 11610 Euclid Avenue, Cleveland 6, Ohio.

ALSO SEND FOR THIS BOOK "Pressurized Power and Controlled Flow by PESCO". This book pictorially tells the story of PESCO equipment, manufacturing facilities and engineering service. A copy will be mailed promptly upon request.

Division Borg-Warner

In Precision Hydraulics, Fuel Pumps, Air Pumps, Related Accessories . . .

PERFORMANCE POINTS TO Pesco FIRST



Built like a Bridge

Simple as a desk fan

The Spencer Turbo-Compressor consists of a few light weight impellers individually balanced and mounted on an oversized motor shaft rotating at low peripheral speeds, with wide clearances all around.

The one-piece casing is made of copper bearing steel, rolled and welded. End heads are made of special ribbed sections and spun rings. The motor is supported by a cast bridge-work that evenly distributes the weight.

The Spencer Turbo can be mounted anywhere without special foundations on the floor—or on the side or top of a furnace, with the discharge in any one of four positions.

THE SPENCER TURBINE COMPANY • HARTFORD 6, CONNECTICUT

257-C

TURBO-COMPRESSORS

"Means have been provided to obtain such capital through government guaranteed T loans, advance partial payments on contract claims or through ordinary loans from banks. The steps banks are taking to prepare for war contractors' financing needs are illustrated by the $50,000,000 credit pool which Chicago banks have just announced."

Mr. Lyon spoke optimistically of the progress being made in handling contract cancellations, saying: "The process of cancellation and settlement of war contracts is being improved and will be further improved. In general we can count on this process being done in a smooth, business-like way."

Although there will be an extensive relaxation of wartime controls after victory in Europe, certain regulations such as those over prices and wages undoubtedly will extend through the entire reconversion period, Mr. Lyon predicted. He declared, however, that every business executive must recognize now that even after the government's wartime regulations are cancelled, his business will be more controlled by government than it was before the war and that in subsequent years government will influence his business increasingly more rather than less.

"It is highly important, therefore, that business play a vigorous and affirmative part in shaping economic and social legislation and regulation during the transition from war to peace. If the goals are to maximize national employment, expand the national income and raise the nation's standard of living, this country will have to rediscover the wealth which lies in private initiative and ingenuity intelligently put to work in the public interest."

Cold Storage Outlook Good

Omaha, Neb.

• • • **The modern cold storage** industry makes it possible for the nation to have a balanced food supply, to the advantage of farmer and consumer, as well as the wholesaler and the dealer, according to C. A. Swanson, a leader in the cold storage field.

"In the postwar world, and with the increased use of deep-freeze cabinets in the home, the cold storage industry is ready to assume new importance to the American family by storing and distributing fresh-frozen foods for every-day consumption," Mr. Swanson believes.

OF *Self-locking* NUTS

The Stover Self-locking Nut is a beautiful example of precision manufacturing—but it "packs tremendous stamina." Sixteen precision machines are employed to make and test it—and to give the vibration-defying ***grip*** that spotlights the Stover nut among modern fasteners.

New in principle, the Stover Self-locking Nut represents a notable advance over other locking devices, especially in its employment of the natural elasticity of metal to give it holding power; its one-piece construction without complicated assembly, and its ability to lock firmly at any point on the bolt.

Evidence of the efficiency of the Stover Self-locking Nut multiplies rapidly in war production where, under Army-Navy specifications, it is giving exceptional resistance to the loosening effects of vibration.

For
BETTER AFTER-THE-WAR MACHINES

Every machine that vibrates will be a better machine if fastened with Stover Self-locking Nuts. Ask to have our representative call on you in relation to your post-war plans.

● *May we send you descriptive literature and samples?*

STOVER SELF-LOCKING NUT

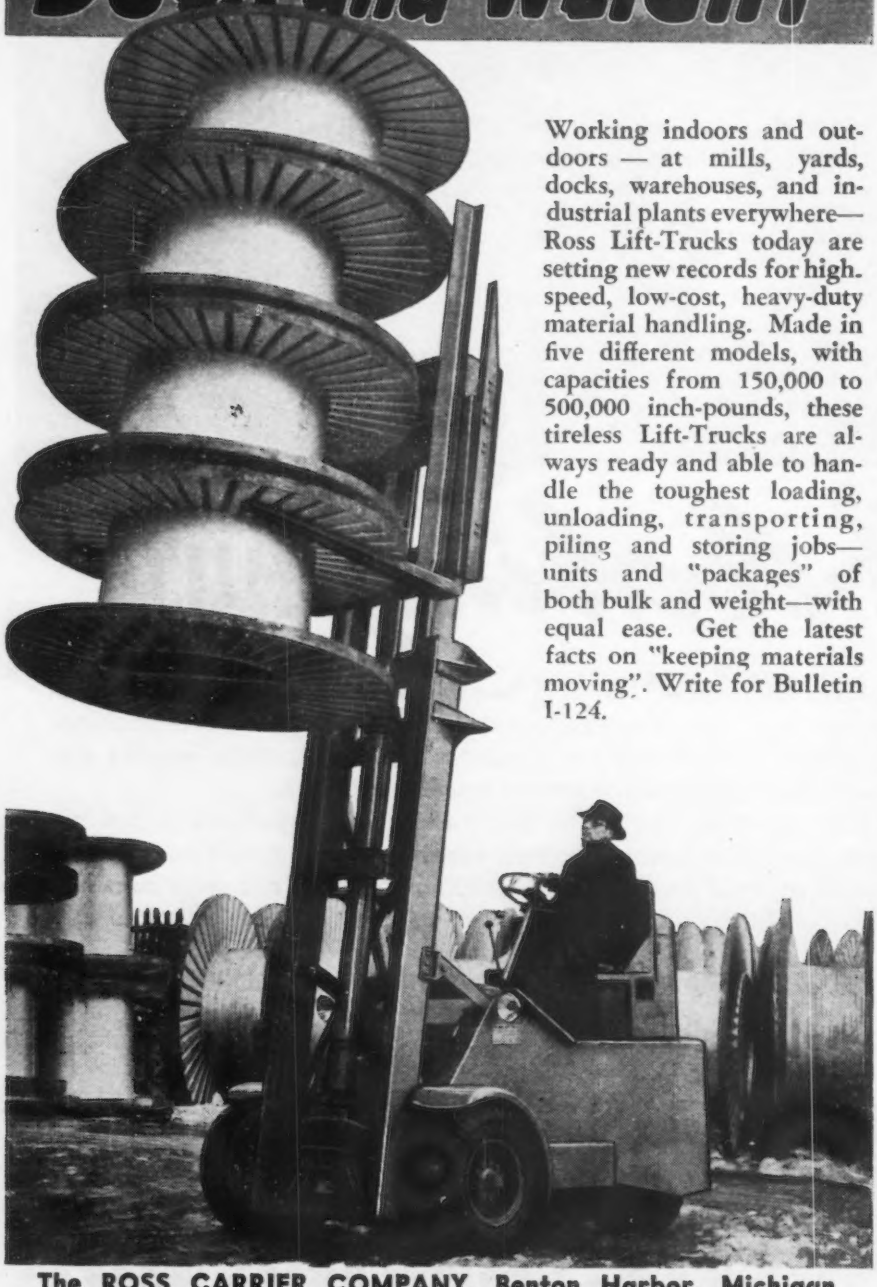
"IT WON'T SHAKE LOOSE"

STOVER LOCK NUT AND MACHINERY CORPORATION

Easton, Penna., Bushkill Drive - New York 17, N. Y., 101 Park Avenue - Detroit 2, Mich., General Motors Building

REPRESENTATIVES IN PRINCIPAL CITIES

Record-Breaking Performance - handling both BULK and WEIGHT



Working indoors and outdoors — at mills, yards, docks, warehouses, and industrial plants everywhere—Ross Lift-Trucks today are setting new records for high-speed, low-cost, heavy-duty material handling. Made in five different models, with capacities from 150,000 to 500,000 inch-pounds, these tireless Lift-Trucks are always ready and able to handle the toughest loading, unloading, transporting, piling and storing jobs—units and "packages" of both bulk and weight—with equal ease. Get the latest facts on "keeping materials moving". Write for Bulletin I-124.

The ROSS CARRIER COMPANY, Benton Harbor, Michigan

Branches: Seattle—Portland—San Francisco—Vancouver, B. C.—New York City—Hoboken, N. J.

ROSS

HEAVY DUTY MATERIALS-HANDLING EQUIPMENT

BENTON HARBOR • MICHIGAN

German Steel Plants Form the Mainstay Of Enemy War Program

New York

• • • **German steel plants,** largest producers in Europe before the war and second only to the United States in world production, have been the backbone of Germany's war machine in both World Wars, says the American Iron and Steel Institute.

Before 1871 the German steel industry was growing relatively slowly compared with France and England. After Prussia defeated France in that year, however, and acquired Alsace-Lorraine with its extensive iron ore deposits, German steelmaking began to expand.

Those ores are high in phosphorus. Not until the development of the basic bessemer steelmaking practice could the Alsace-Lorraine ores be fully utilized. Even then, the result is generally considered by steel men to be somewhat inferior in quality to open hearth or electric furnace steel as well as to the steel produced in this country by the acid bessemer process.

Industrialization of Germany proceeded rapidly after the Franco-Prussian War. As a result, by 1913 Germany was producing twice as much steel as England and four times as much as France.

Defeat in 1918 and the Treaty of Versailles that followed took away from Germany well over half the iron ore production which German plants had been using and also about one-third of the country's steel capacity.

Nevertheless, by 1922 the German steel industry was once again the leading European producer, turning out 13,000,000 net tons of steel, as against 6,600,000 tons in England and 5,100,000 tons in France.

During the 1920's a substantial part of German steel production was exported. In 1926, for example, German steel plants shipped out of the country about half their total production, For that reason, the world-wide depression of the 1930's hit the German steel industry hard for a time.

Steel production in Germany and the Saar nearly trebled in tonnage between 1933 and 1937—partly because of improvement in world conditions but also because of the large amount of steel which went into armament. That increase in production was accomplished without much new plant construction. Instead, existing plants were utilized to their fullest capacity.

Germany's lack of adequate and

pushes a button

On this Cross Special Machine, truck and tractor axle housings are automatically bored and faced *at new standards for low cost*

This Cross Special Boring Machine is a universal machine for simultaneously boring and facing the banjo housings on a wide variety and range of automotive truck and tractor axle housings. It bores and faces the flanges and inner lugs on front and rear axle housings during a full automatic operating cycle.

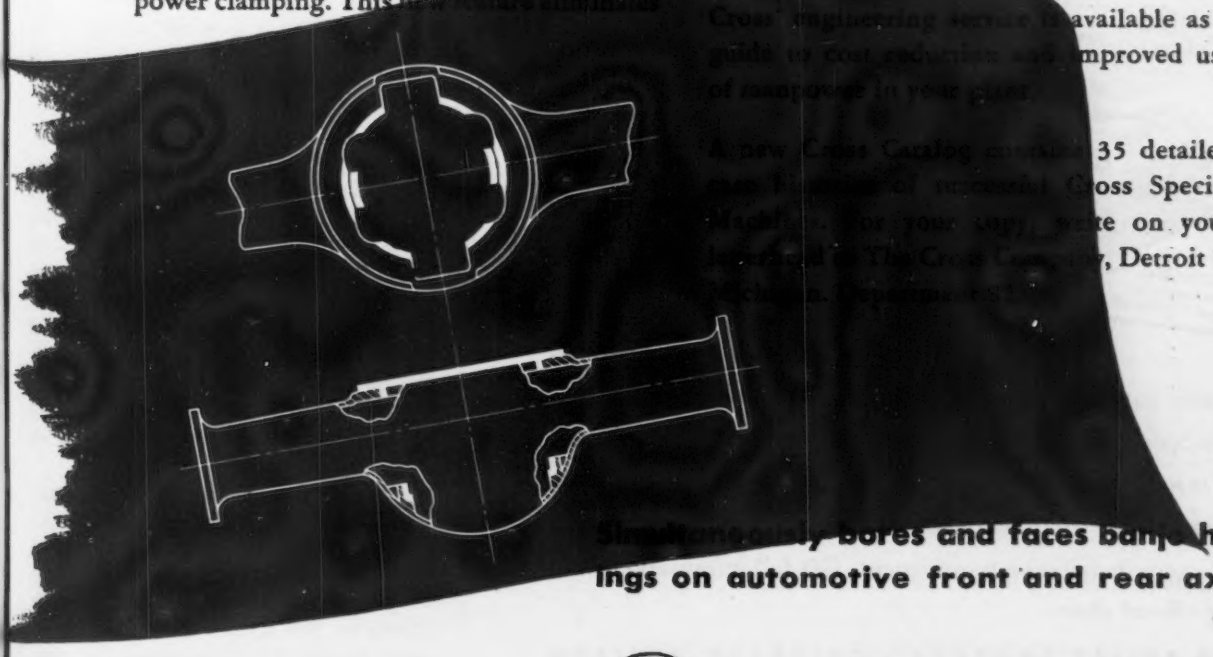
The work is located in the fixture with a proper operated gauging mechanism for automatically dividing the stock [illegible] to power clamping. This new feature eliminates the old practice of manual location, as well as surface plate layout and subsequent gauging to layout lines.

Cross Special Machines, with full automatic operating cycle, eliminate the human element and thereby maintain precision accuracy with unskilled labor.

Other Cross Special Tools include automatic machines for completing any one or a combination of turning, milling, drilling, boring, reaming, tapping or grinding operations at the push of a button.

Cross' engineering service is available as a guide to cost reduction and improved use of manpower in your plant.

A new Cross Catalog contains 35 detailed [illegible] of successful Cross Special Machines for your application on your [illegible], write The Cross Company, Detroit 7, Michigan. Department [illegible]



Simultaneously bores and faces banjo housings on automotive front and rear axles.

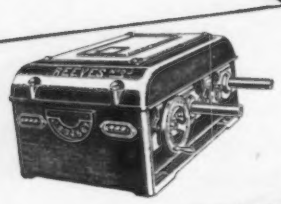
S 15

SPECIAL MACHINES

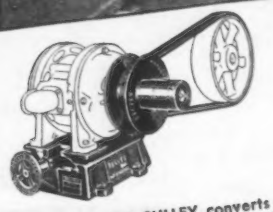
for automatically performing any one or a combination of metal cutting operations
TURNING · MILLING · DRILLING · BORING · REAMING · TAPPING · GRINDING

Industry's Preferred METHOD OF SPEED CONTROL

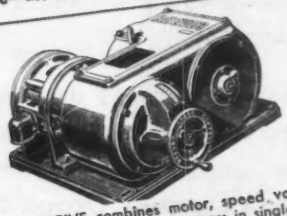
☆ ☆ ☆



VARIABLE SPEED TRANSMISSION for providing infinite, accurate speed flexibility over wide range—2:1 to 16:1. Sizes fractional to 87 h.p.



VARI-SPEED MOTOR PULLEY converts any standard constant speed motor to a variable speed drive with 4:1 ratio. Sizes to 15 h.p.



MOTODRIVE combines motor, speed varying mechanism and reduction gears in single unit. Speed variation 2:1 to 6:1. Sizes to 15 h.p.

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This authoritative 128-page book on variable speed control describes the complete REEVES line of speed control equipment. Ask for Catalog-Manual IG.

● The definite preference of plant superintendents, machine shop foremen, and operators for REEVES Variable Speed Control is not hard to understand. No other speed control is so flexible, so infinitely variable, so positive and dependable in operation. No other offers so many types and sizes of units to meet every installation requirement. Get full information from Catalog offered above.

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Accurate Variable REEVES SPEED CONTROL

high grade iron ore deposits required her to import large tonnages of ore from other countries. Even in years of smaller steel production some ore was imported from Sweden and elsewhere, largely to obtain richer ores than were obtainable from German mines.

Realization of this dependence upon outside sources for ore was one of the principal reasons for the establishment in 1937 of the so-called Herman Goering Works, at Salzgitter in central Germany. Choice of the location was determined both by its distance from the French border, which put it out of convenient bombing range, and also by the fact that large deposits of low-grade iron ore existed there.

Large-scale mining operations and a fully integrated steel plant were built at Salzgitter. It is believed that the annual production goals of 10,000,000 tons of ore and 4,000,000 tons of steel were never reached. France fell before the plant was ready for full operation, making available adequate supplies of richer ore from the French mines.

Many iron and steel plants in conquered Europe, however, were taken into the Goering Works combination, which became a holding company as well as an operating unit as originally conceived. Others were taken over by various private German companies.

The result was a well-integrated, pan-Central-European steel industry.

At the crest of German power, close to 60,000,000 tons of steel capacity was available in Axis Europe, of which perhaps as much as 28,000,000 tons were in Germany itself. Since then, through the loss of most of Italy, France, Belgium, Luxembourg, the Balkans and Hungary, the amount of steel capacity available to Germany has probably decreased to not more than 36,000,000 tons.

Furthermore, plants in the Saar and Ruhr areas, which have borne the brunt of bombing, were the principal German producers of high quality steels. Loss of production in such plants as the Krupp works at Essen could hardly be fully offset by continued or even increased output of lower grade steels in other plants.

Even if the Goering Works and some of the other steel plants in central Germany were to come through the war without serious damage, they may experience great difficulty in competing in quality as well as in cost of production with plants in the Ruhr and with certain other plants located elsewhere in Europe.

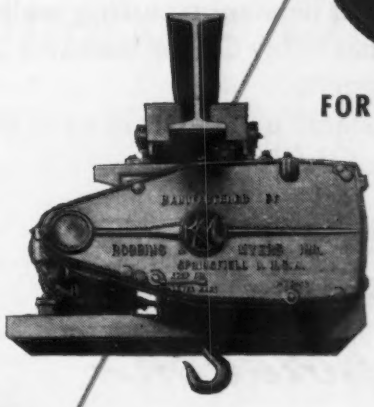
The "LIFT" that LOWERS Unit Costs

INCLUDE THIS "HOOK" IN YOUR POSTWAR PLANNING

Will you be able to drive a wedge between *cost* and *selling price* in the days that lie ahead? Look to tomorrow's overall operations for your answer. But look to *unit production expense* for your *savings opportunities.* R & M hoists and cranes—the "lifts" that lower unit costs—can help you bring costs *down.*

● Machines will multiply tomorrow's muscle in a thousand different ways—machines which fit into the new scheme of things as never before. That's why Robbins & Myers offers *hundreds* of combinations in dependable designs; why R & M specialists tailor their recommendations to the job; why you can look to R & M for the right answers.

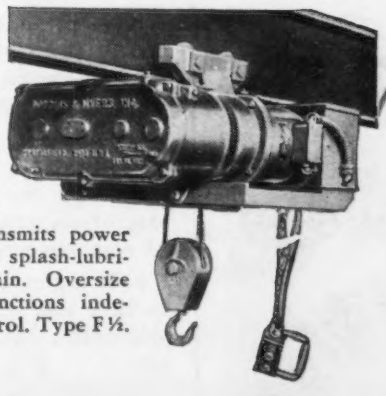
● Let our experience be your guide in planning now for *lower unit costs.* Write or telephone your nearest R & M Sales and Service Office today. Only the *right* machine for the job can do that job of yours *best.* Robbins & Myers knows hoists and cranes, and builds them *right* for *every* service need.



FOR LOADS UP TO 15,000 LBS.

• A sturdy, pendent-push-button-controlled hoist with safety frame of strong electrically welded steel. Hoisting mechanism is free from complicating "gadgets," and easily accessible. Durable automatic load brake requires no adjustment for years at a time. The fully enclosed alloy-steel gear train is splash lubricated. Motors from 2 to 9 H.P. Type FNo. 1. *Ask for Bulletin No. 801.*

A SPEEDY HOIST FOR UP TO ONE TON



• A compact, low headroom, welded steel-frame hoist — quality-built throughout. Furnished for hook suspension or with plain or motor-driven trolley, or arranged for mounting on ceiling or floor. The 1¼ H.P. hoist motor transmits power through a fully enclosed, splash-lubricated, alloy-steel gear train. Oversize automatic load brake functions independently of operator control. Type F½. *Ask for Bulletin No. 800.*

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Chicago.....2400 W. Madison St.	New York.....200 Varick St.
Cincinnati.....418 New St.	Philadelphia....401 N. Broad St.
Cleveland...470 Rockefeller Bldg.	Pittsburgh....H. W. Oliver Bldg.
Dallas.....1100 Cadiz St.	Providence.....44 Clifford St.
Denver.....1420 16th St.	San Francisco, 116 New Mtgmry St.
Detroit.....2921 E. Grand Blvd.	Seattle.....216 Walker Bldg.
Houston....3715 Harrisburg Blvd.	Syracuse...204 State Tower Bldg.
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If you want cap screws that are *right,* specify Oliver. Made to close tolerances by modern manufacturing methods, Oliver Cap Screws meet your most rigid requirements.

Oliver "Know-how" has been gained through the manufacture of fasteners since 1863. For four score years, Oliver has been constantly perfecting and improving its manufacturing methods and products—so that today Oliver fasteners lead in quality and uniformity.

For complete satisfaction in cap screws or other fasteners—*specify OLIVER!*

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IRON AND STEEL
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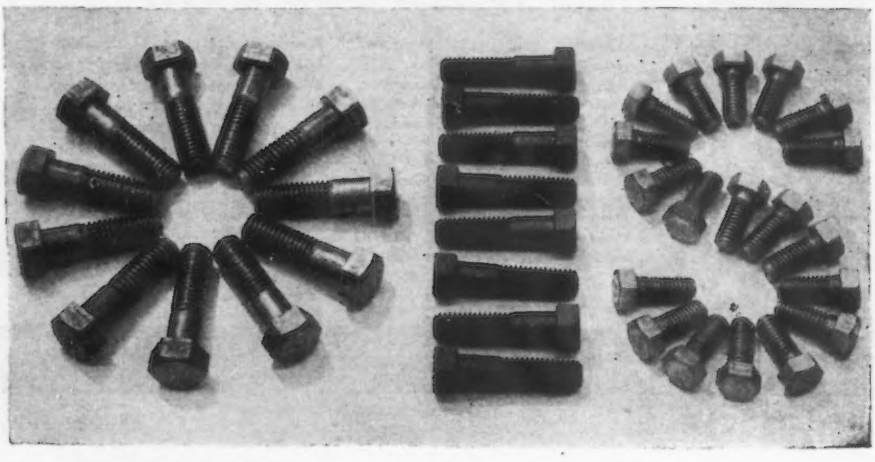
MAKERS OF POLE LINE MATERIALS SINCE 1894



NAM Behind Program To Assure Postwar Jobs for Employees

New York

• • • **The National Association** of Manufacturers announced recently it would carry to the public for acceptance and support a six-point program specifying the action that business will take to assure jobs and higher living standards in the postwar period. Ultimate objective of the association's long term program is prosperity during the postwar period which will enable Americans to "earn more, buy more, and have more."

Walter B. Weisenburger, executive vice president of NAM, in announcing the program stated: "Until victory is achieved every resource of industry will be mustered behind the millions of American fighting men and women on the battle fronts.

"Beyond victory, industry is prepared to assume its full responsibility in utilizing these same resources to build a better nation.

"Public acceptance is sought for NAM's six-point program as a charter for business action. If industry is to proceed at full speed to activate an upward economic trend, there must be a combination of effort and the realization on the part of both public and industry that they have an identical goal—jobs and freedom of opportunity. Productive jobs for all who want them in the postwar period are our chief objective. From productive jobs stems buying power which is the motivating force that turns the wheels of industry.

"The six points of NAM's program of business action, all of which add up to more and better jobs, are:

1. Offering better values for consumers by improving production and distribution methods, which will make available more and better goods and will stimulate employment.

2. Insistence upon full and free competition to reduce prices and to encourage the establishment of new enterprises, again stimulating increased employment.

3. Bold investment of risk capital to back new enterprises and expand production, which will also make more jobs.

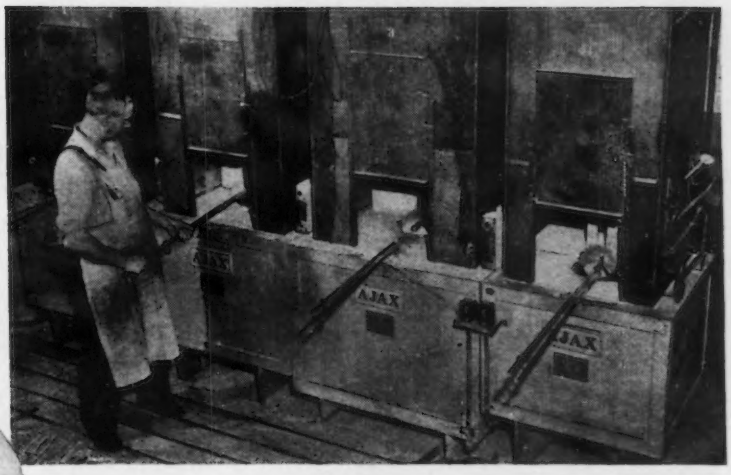
4. Adherence to wage policies which give workers a fair reward for work accomplished.

5. Providing better tools and improved working conditions as an aid to higher production and fatter pay

A 3-YEAR USER REPORT

from MURCHEY MACHINE & TOOL CO.

Detroit, Michigan



Treating High Speed Tools in Ajax Furnaces

L. E. Walker, General Manager and J. B. Coyle, Sales Manager, discuss fine points of Murchey Types "CO" and "CM" precision cutting heads and dies hardened in battery of Ajax Salt bath furnaces shown above.

Such Low Maintenance is Characteristic!

Reputation of Murchey products and their widespread user satisfaction is no mere happenstance. Modern production methods and their choice of Ajax Furnaces for heat treating their output of thread cutting tools tells the story. Consider this report from L. E. Walker, Murchey General Manager:

"On the 22nd of September, 1944, it will be three years since we started our battery of Ajax electric salt bath high speed furnaces.

"The ceramic pot in the high heat unit, operating temperature up to 2380° F, ran constantly for two years and two months before we had to replace it. The replacement pot shows no deterioration to date.

"In the three other furnaces in this battery, the original pots are still in operation, and they all appear to be about as good as new.

"You told us our AJAX maintenance would be low, but we did not think it could be this low. We wish to compliment you on the design and construction of these furnaces." . . .

Most other manufacturers of high speed steel tools also use Ajax Furnaces exclusively, in fact—SALT BATHS ARE NOW USED TO A GREATER EXTENT THAN ANY OTHER METHOD. Write for any of the following technical treatises:

Hardening High Speed Taps and Dies in the Electric Salt Bath, by Paul C. Farren.
Liquid Carburizing of Transmission Gears, by W. A. Silliman.
Carburizing Gears in the Electric Salt Bath Furnace, by William F. Sorenson.
Electric Salt Bath Treatment of Aluminum Aircraft Alloys, by C. Santore.
Merits of Salt Baths and Air Furnaces (for Heat Treating Aluminum Alloy Parts), by James Snider.
Isothermal Quench Baths Applied to Commercial Practice, by H. J. Babcock.
Salt Bath Quenching Processes, by H. J. Babcock.
Salt Bath Hardening of NE Steels, by L. J. Sheehan.
Catalog 107-B—Ajax-Hultgren Electric Salt Bath Furnaces.

AJAX AJAX ELECTRIC CO · FRANKFORD AVE · AT DELAWARE AVE · PHILADELPHIA 23 · PA ·

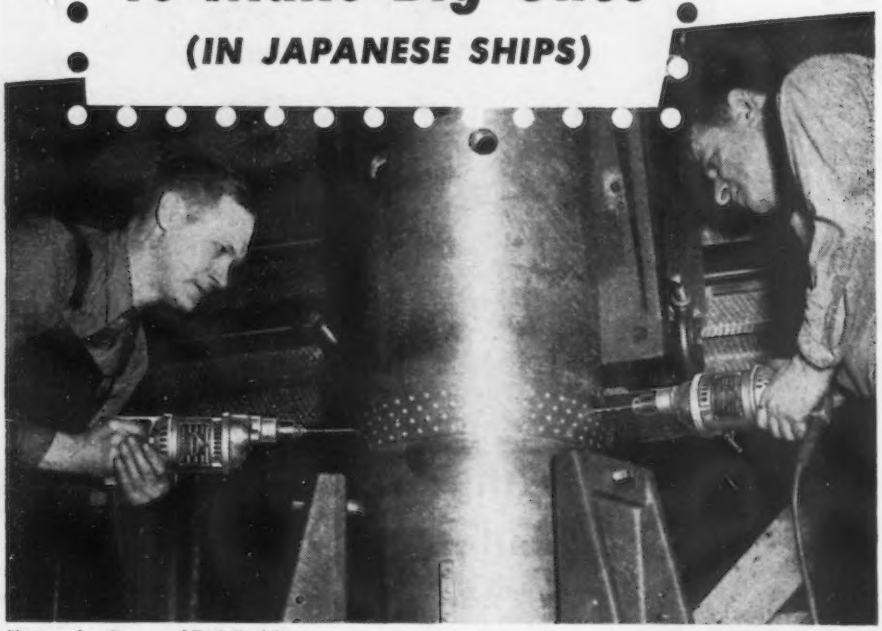
HULTGREN ELECTRIC SALT BATH FURNACES

AJAX METAL COMPANY, Non-Ferrous Ingot Metals and Alloys for Foundry Use
AJAX ELECTRIC FURNACE CORP., Ajax-Wyatt Induction Furnaces for Melting
AJAX ELECTROTHERMIC CORP., Ajax-Northrup High Frequency Induction Furnaces
AJAX ENGINEERING CORP., Ajax-Tama-Wyatt Aluminum Melting Induction Furnaces

A S S O C I A T E
C O M P A N I E S

Drilling Little Holes to Make Big Ones

(IN JAPANESE SHIPS)



Photograph—Courtesy of The Bullard Co.

Millers Falls Electric Drills were chosen for the task of drilling hundreds of rivet holes in sections of aircraft torpedoes, in the revolutionary, new, vertical, mass-production method of torpedo assembly recently announced by The Bullard Company, Bridgeport.

Envelope jigs control the drilling of as many as 551 holes at a setting.

Electric drills to carry this tremendous continuous-production load had to be sturdy, precise and powerful. Millers Falls No. 414 drills meet every requirement.

There are equally fine, sturdy, precise Millers Falls production tools for every purpose. Consult the Millers Falls Electric Tool Distributor nearest you. His name will be sent on request.

No. 414 DRILL

MILLERS FALLS TOOLS SINCE 1868

MILLERS FALLS COMPANY

GREENFIELD, MASSACHUSETTS

envelopes for individual workers.

6. Keeping open all possible advancement opportunities for the individual worker, to encourage initiative and greater production by assuring that such personal effort on the part of workers will be rewarded.

"NAM's platform," Mr. Weisenburger added, "has been kept simple and direct and is keyed to the national welfare. If the people want to reap the full advantage of the action which industry will take, the public can play a vital part. Unregulated monopoly must be eliminated in the public interest. Postwar tax policies should leave sufficient funds for expansion of job-making production. Labor policies should place equal responsibility upon labor and management, and business regulation should be through legislation, instead of directives."

Steel Medical Experts Form Committee On Veterans' Problems

New York

• • • **To help solve the** problems of reorienting former steelworkers returning from military service, doctors heading up the medical departments of leading steel companies have been organized as a committee of American Iron and Steel Institute.

Mobilization of the medical men is one of many steps which steel companies have taken to prepare for the return to civil life of many thousands of former employees. Already more than one out of every 20 steel employees who left for military service has returned, and to date their re-employment and reorientation has been accomplished with little difficulty.

One of the first tasks of the Committee on Industrial Health is a study of the programs set up by various companies in the industry for rehabilitating war veteran employees needing special consideration in re-employment.

That study, now under way, may result in specific recommendations of special types and techniques of medical examinations and also of rehabilitation possibilities for specific disabilities. The committee is likewise expected to survey the various jobs in steel plants to determine which jobs can be handled safely and with satisfaction to both employee and company by veterans with specific disabilities.

hard surfacing electrodes

RACO 25 Shielded Arc Electrodes produce excellent results in building up worn parts and surfaces on which a tough deposit of moderate hardness is needed, such as shafts, gear teeth, hawser pipe and crane wheels. RACO 25 Electrodes meet the requirements of U. S. Navy Specification 46E3 (INT) Grade EE. Hardness range: 20-25 Rockwell C. Machinable.

RACO 45 Shielded Arc Electrodes—for surfaces which require no machining, but which must resist severe wear and abrasion, such as shaker screens, wheel flanges and tractor treads. RACO 45 Electrodes meet the requirements of U. S. Navy Specification 46E3 (INT) Grade ED. Hardness range: Rockwell 40-50 C.

RACO 55 Shielded Arc Electrodes—for building up surfaces requiring still greater hardness than that provided by RACO 45 Electrodes, such as dipper teeth, crusher pads, brick-making machinery and cement mill equipment. Hardness range: 50-60 Rockwell C.

Welding qualities of these three grades of RACO Electrodes are essentially the same. Either direct current (straight polarity) or alternating current may be used. Vertical welding may be done with each grade in 3 16" diameter and smaller. Deposits are dense, and requisite hardness is obtained in single layer as well as in multiple layers. No heat treatment is required.

Send for free samples of these RACO Electrodes. Test their top-performance qualities to your own satisfaction. Just write

The REID-AVERY COMPANY

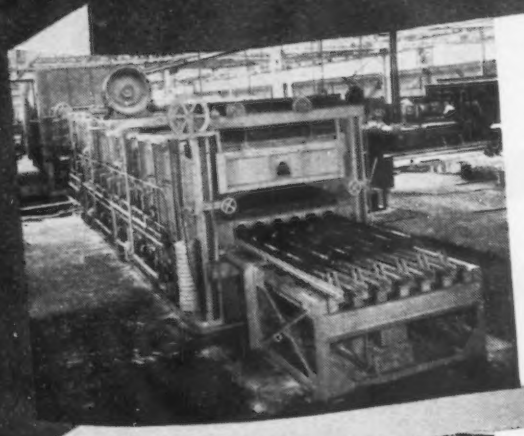
DUNDALK BALTIMORE 22 MARYLAND

SINCE 1919 PRODUCERS OF ARC WELDING ELECTRODES AND WELDING RODS

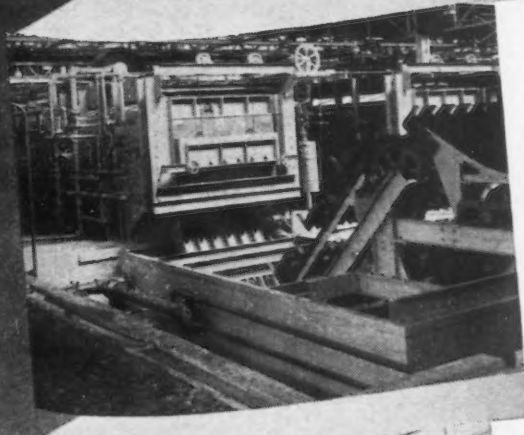
It Takes the Best to Make the Best

Prepare

for Post-War Production with R-S Continuous Furnaces



Unexcelled engineering ability in the production of heat-treated heavy artillery shells is exemplified by this automatic, gas-fired R-S installation. The shells are pushed through the hardening furnaces in six parallel conveying tubes.



Shells are quenched internally and externally, then leave the quench tanks on continuous conveyors.

The draw furnaces, through which the shells move on alloy chains. The result is uniform heat-treatment and low cost production.

FURNACE DIVISION

R-S PRODUCTS CORPORATION

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R-S Furnaces of Distinction

PLATE AND ANGLE HEATING

ANNEALING CONVECTION CAR HEARTH ROTARY HEARTH

CONTINUOUS CONVEYOR SALT BATH FORGING METAL MELTING

Buy War Bonds

First Postwar Year To See Construction Volume Matching 1938

New York

• • • **Construction activity** in the United States during the first twelve months after an Allied victory in Europe, or after that day when most war controls on materials and man power are relaxed, whichever is earlier, is likely to approximate the volume of the year 1938, according to estimates made by F. W. Dodge Corporation.

The 1938 contract volume for the 37 states east of the Rocky Mountains, was $3,197,000,000, as compared with an indicated final contract total for the current year 1944 of approximately 2 billion dollars.

"The extent of construction industry revival that will take place in the calendar year 1945 hinges directly upon the victory time-table," Thomas S. Holden, president of the Dodge corporation states. "Victory in Europe before mid-January, 1945, would likely result in a year's contract volume 50 to 60 per cent greater than that of the calendar year 1944; victory in March, 1945, would probably result in a 20 to 25 per cent increase in the next calendar year over the current one; victory on June 1, 1945, or thereafter would probably mean a 1945 construction program about equal to that of this year," Mr. Holden said.

"While potential demand is large, and while the industry itself (outside of some manufacturing lines) has no reconversion problem, the real question is as to the speed with which certain temporary bottlenecks can be overcome or with which full peacetime demand can become effective," Mr. Holden said.

The principal bottlenecks are government controls, material supply problems, price problems and manpower problems, he said.

Mr. Holden said that the most comprehensive direct evidence of postwar construction demand consists in the 55,140 listed projects reported by the field staff of the Dodge corporation. The estimated total cost of these projects is 11 billion dollars. Of these projects 20,798, amounting to 5.1 billion dollars, have been reported in the design stage.

"Designed projects, in estimated dollar value, amount to 60 per cent more than the total dollar volume of contracts awarded in 1938. It is to be noted, however, that these reported

There's a Big Swing to Less Common Metals

in "The POLLAK Version of Re-conversion"

No one will deny that production for war has substantially contributed to the techniques of design and manufacture of products from the lighter metals as well as the slower oxidizing metals.

But this skill and knowledge, born of war's necessities, can and will be turned to the advantage of the public through the manufacture of parts for peace-time products such as automobiles, refrigerators, washing machines, office appliances and the like.

This redesigning of parts and products utilizing stainless steels, Monel, Inconel and aluminum as well as steel and brass is an integral part of the Pollak Version of Reconversion. We are ready to pool Pollak techniques and experiences with these metals with the product planning ideas of engineers and sales staffs of American Industry.

The Pollak Version of Reconversion has already resulted in the redesigning and respecification of parts made of these metals for a number of products for consumer use! Our engineers and development experts may be able to help other firms modernize their products. Consultation invited without obligation.

POLLAK
PRECISION
PRODUCTS

POLLAK MANUFACTURING COMPANY

Arlington, New Jersey

DEVELOPING · DESIGNING · MACHINE WORK · SPINNING · GAS AND RESISTANCE WELDING · STAMPING · ELECTRICAL WORK

IN SPEEDING UP the fitting of machine parts by eliminating the precision machining otherwise required, Laminum shims actually add to the certainty of uniform accuracy . . . you simply peel laminations of known precision gauge from the solid shim. Bulletin on request.

Laminum shims are cut to your specifications. For maintenance work, however, shim materials are sold through industrial distributors.

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LAMINUM

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2217

postwar projects include a preponderance of public construction. The high total value of public postwar projects reflects the numerous pressures put upon public officials to prepare ambitious postwar plans, and the fact that large numbers of local public projects were planned in anticipation of federal subsidies, not at all likely to be forthcoming in 1945.

"It seems necessary to present this explanation of the postwar project tabulation in order to show that, valuable as it may be as evidence of the existence of demand for construction in all important categories, detailed figures do not indicate the pattern of an actual construction program of any particular postwar year. The listing represents a nucleus of specific plans out of which future construction activity will grow. It contains no figures on deferred maintenance, repairs, alterations and modernization," Mr. Holden said.

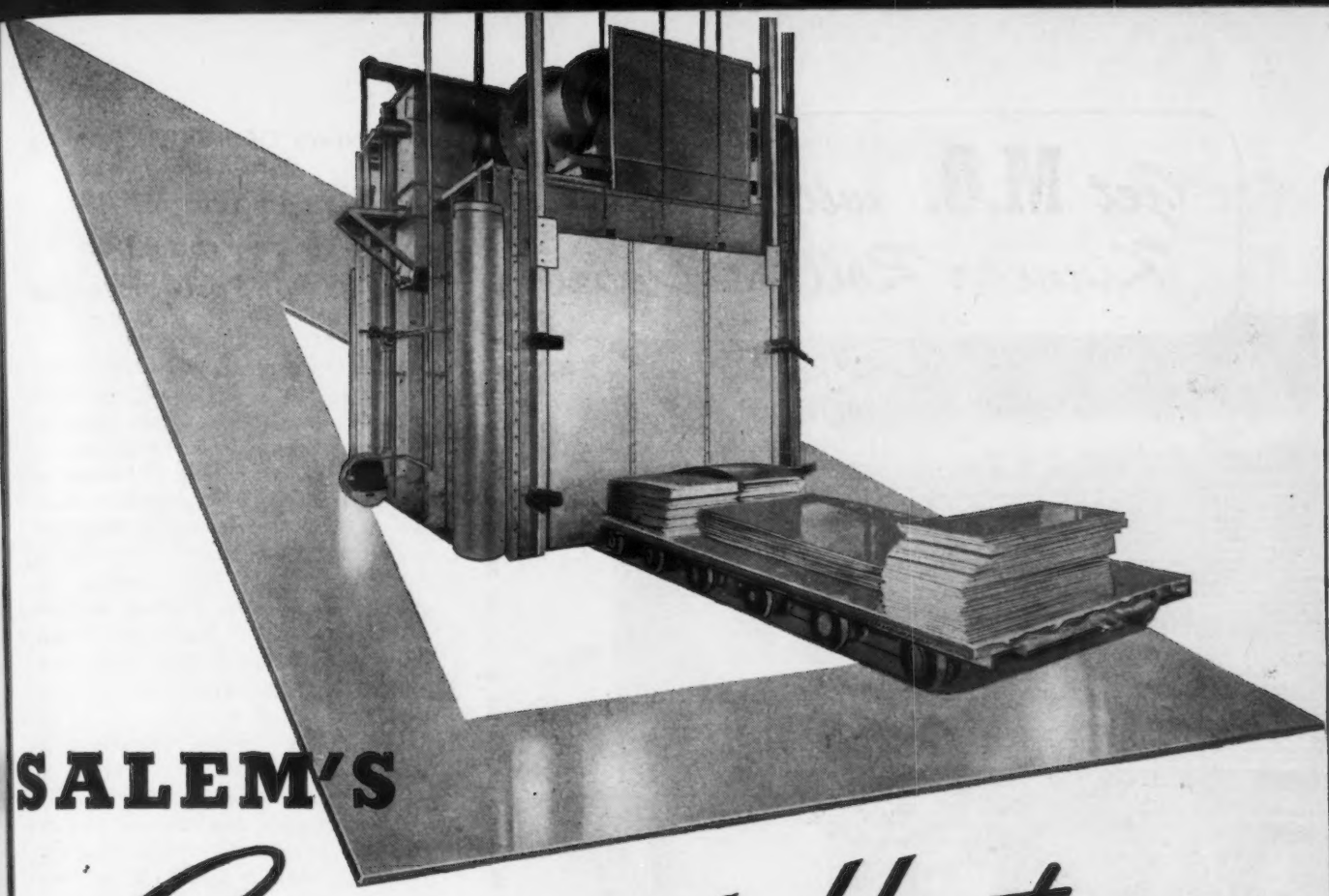
Mr. Holden remarks that relaxation of construction limitation orders has already begun, but draws attention to the fact that it will be several months after X Day when controls are more widely relaxed before adequate supplies of certain important construction materials and equipment will be available.

"Various surveys," Mr. Holden says, "have indicated that three to six months will be required, after green lights have been given, to produce supplies adequate in quantity and variety of such fabricated items as metal windows, plumbing fixtures, heating equipment, and builders' hardware."

Abrasive Grain Size Practice Being Revised

• • • **Revision of** Simplified Practice Recommendation R118, Abrasive Grain Sizes, has been approved by the standing committee in charge and copies are out for consideration and acceptance. This recommendation covers a simplified schedule of grain sizes for aluminum oxide and silicon carbide abrasives for polishing uses and for grinding wheel manufacture. The proposed revision recommends an increase in allowable oversize in No. 46 grit from 20 to 30 per cent and the inclusion of No. 240 grit.

The changes are the first to be made in the table of grain sizes since 1930, when the recommendation first became effective. Copies of the proposed revision may be obtained from the Division of Simplified Practice, National Bureau of Standards, Washington 25.



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APPLIED TO ALUMINUM!

A customer requested Salem to design a new type of low temperature furnace for heat treating aluminum sheets and plates.

Salem engineers came up with a unique method of convection heating, incorporating several new ideas. Result — the buyer has what he wants . . . uniform, consistent production with no remelting or reheating.

Salem builds all sizes and styles of heat treating furnaces for any fuel: batch, car, rotary, and many special types.

We design the equipment for specific production requirements of the individual customer, combining engineering with economics.

Our engineers call the Salem service — "Engineered Heat." Others tab it—Salem Ingenuity.

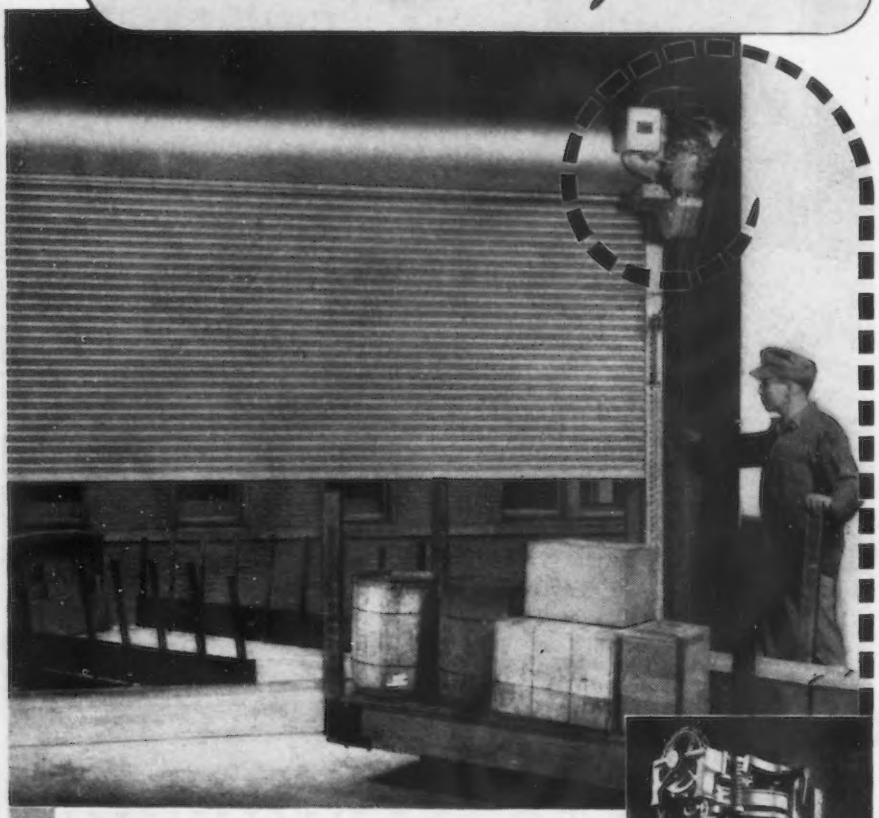
Check your 1945 heat treating requirements with Salem. Prompt attention to your heat treating inquiry.

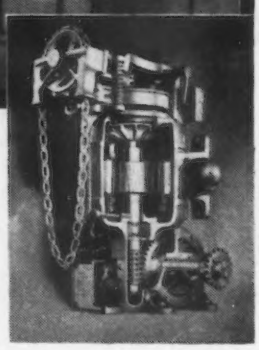
SALEM **SALEM** OHIO

ENGINEERING CO.

SALEM ENGINEERING COMPANY

Get M.O.* with Kinnear Rolling Doors





Sectional view showing the rugged construction of the Kinnear Motor Operator.

*More Output with Motor Operation

Speed up door activity — make sure your doorways are equipped to give you "M.O." by installing Kinnear Motor Operated Rolling Doors. You simply press a button and the sturdy, dependable Kinnear Motor Operator opens the doors straight upward into a compact coil above the lintel. You'll find that this ease of operation encourages prompt closing of doors. The shortened opening and closing cycle reduces heating and air-conditioning costs, helps maintain an even comfortable temperature. Kinnear Motor Operation also provides for remote door control to meet any requirement. Doors may be operated from several points, and any number of doors may be centrally operated. You'll gain savings in time and manpower. Get full details on Kinnear Motor Operated Rolling Doors — discover how soon motor operation pays for itself. Write today!

The Kinnear Manufacturing Company,
1760-80 Fields Avenue,
Columbus 16, Ohio.

SAVING WAYS IN DOORWAYS

KINNEAR ROLLING DOORS

Wages and Salaries Tied to Production In Postwar Period

New York

• • • **Wage scales and** market prices should be allowed to find the levels that will produce maximum employment and maximum national income through the bargaining processes of private industry, F. D. Newbury, vice-president and economist of Westinghouse, said recently.

Explaining that his opinions on postwar wages were his own and not necessarily those of his company, Mr. Newbury told a production conference of the American Manufacturers Assn. here:

"I am in no sense recommending that wages be either lowered or raised, but recommend that we simply return to the pre-war practice of bargaining. As soon as civilian business returns, it will be safe to allow bargaining to determine wage rates."

Pointing out that if higher pay is expected we must have more efficient production, Mr. Newbury added:

"Total wages and salaries paid out over the long term must, if industry is to remain self-supporting and solvent, come out of total national production. Actually, a wage scale that is too high can reduce employment and total purchasing power."

He stated that higher wage scales have not appreciably increased the employees' share of national production and that the total wage and salary fund can be increased substantially only by increasing total national production and total national income.

"Actually," Mr. Newbury added, "all of us gain together, or all of us lose together. It should be reassuring to employes, to labor leaders, and to employers alike that during the past 15 years—through prosperity and depression—the total wages and salaries paid out have, over the years, constituted a surprisingly constant and predominating share of the national income and national production."

The figures for three significant peacetime years, 1929, 1932 and 1940, show that wages and salaries amount to 53.3 per cent, 57.2 per cent and 54.1 per cent, respectively, of the total national production for those years, he said.

"Throughout this period, including the boom year of 1929, the depression year of 1932, and the moderately good year of 1940, the share of the total

BETTER LUBRICATION *means* BETTER MAINTENANCE

IF you are experiencing difficult maintenance, better check lubrication. It may be inadequate with resultant excessive wear.

Sinclair offers better lubrication for better maintenance of MACHINING equipment with specialized hydraulic, spindle, gear and general purpose oils ... also highly efficient cutting oils and coolants for all machining operations, speeds, and metals.

• • •

(Write for "The Service Factor"—published periodically and devoted to the solution of lubricating problems.)

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FOR POSTWAR MANUFACTURE OF YOUR DECORATED METAL PRODUCTS

Give your postwar products the sales-building features of *decorative beauty, functional design, and eye-appealing color and finish!* For 69 years GRAMMES has specialized in the creation and manufacture of decorated metal products for the automotive, aviation, radio, refrigeration, gift, stove, toy, novelty, and many other industries.

To facilitate your pre-conversion plans for new product development and product improvement, GRAMMES Contract Service offers Research, Design, and Engineering aid NOW. Newly perfected processes and production techniques plus increased plant facilities enable us to handle a few additional accounts requiring volume production.

The production facilities listed offer a complete, *centralized* setup for economical precision fabrication and mass assembly. Preliminary estimates given on completed products and assemblies. Let us work with you, complete confidence assured.

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DECORATED METAL PRODUCTS SPECIALISTS

—applying artistic designs and finishes that add beauty and color to your product.

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L. F. GRAMMES & SONS, INC.
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NEW YORK CHICAGO DETROIT CLEVELAND MILWAUKEE PHILADELPHIA

production paid out in wages and salaries remained about the same, and the share in 1932 was greater than the other two years," Mr. Newbury explained.

At the same time, he continued, corresponding corporate profits, both profits paid out as dividends and surplus retained by the corporations, showed wide fluctuations between good and bad years with 7.2 per cent of the national production in 1929 as the share of total profits and 6 per cent in 1940, but in 1932 industry lost 6.5 per cent.

Urging labor, the government and business to take steps to permit normal adjustments in industry to reestablish new balance points for wage scales, labor costs and market prices in individual situations, he stated:

"No person or government board is wise enough to answer questions on wage and price policies for the post-war era. And no answer can be right for the thousands of individual situations in industry. We need economic answers to these economic questions, just as quickly as orderly conversion will permit."

Philco Executive Sees Radio Demand Of 20 Million Sets

Philadelphia

• • • **Great new products** developed by the nation's scientists and engineers together with more than $100,000,000,000 of cash and bank deposits in the hands of the public will insure a period of intense business activity in the post-war period, it was predicted recently by Harry Boyd Brown, national merchandise manager for Philco Corporation, in an address entitled "Post-war Production and Consumption" before a meeting of women leaders sponsored by the National Association of Manufacturers at the Bellevue-Stratford Hotel.

"The research laboratories of this country, and the amazing resourcefulness of the engineers, inventors, production experts and the men and women of America have accomplished the greatest war production miracle in the history of mankind," Mr. Brown said. "Equally great achievements can be expected when peace returns.

"Great advances have been made in the field of electronics, although war secrecy still prevents discussion of them," Mr. Brown pointed out. "Electronic enumerators count passing articles far faster than the eye can see.

A BIG Brake for Large Motors

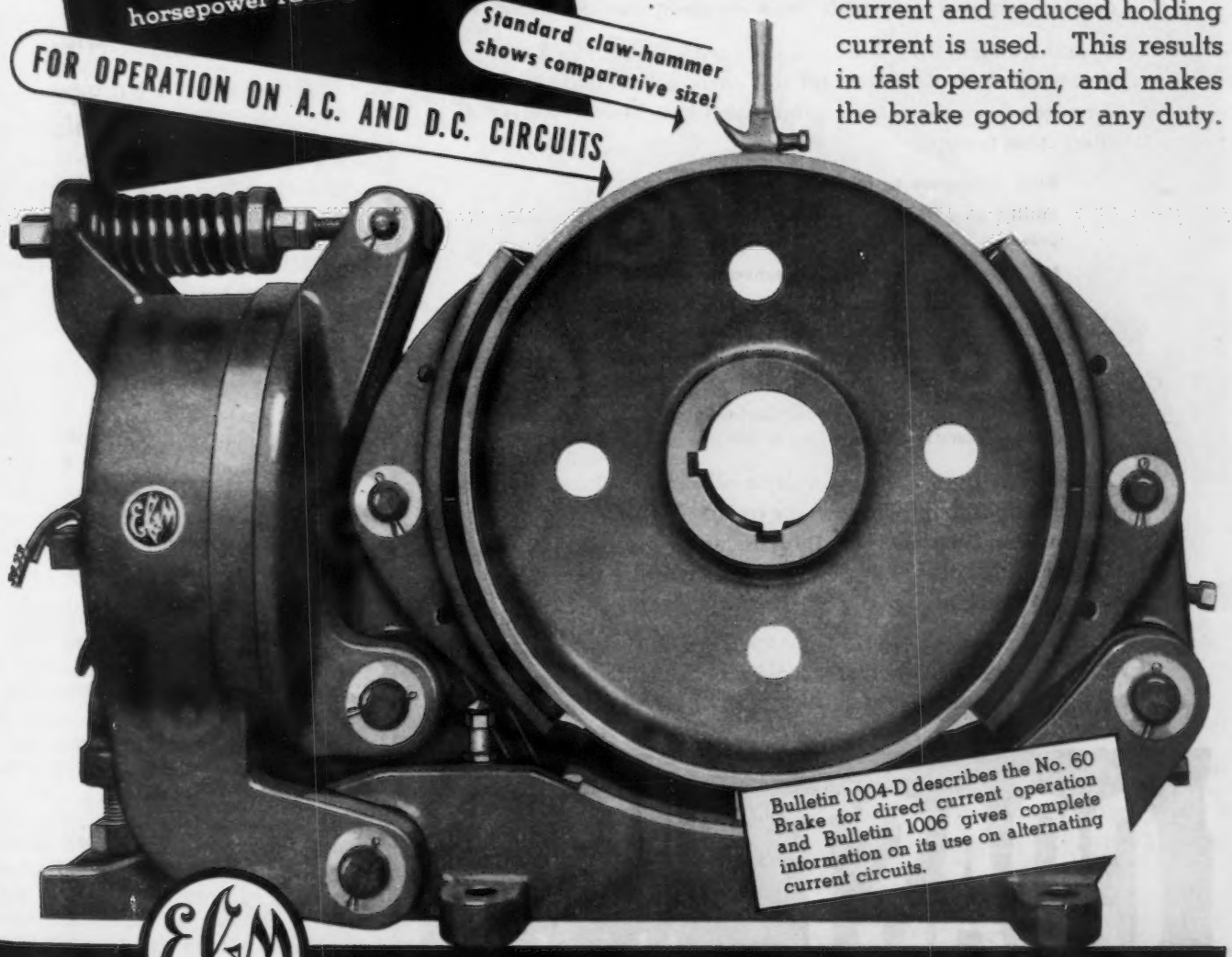
THE NEW EC&M NO. 60 WB BRAKE Rated At 7200 lbs./ft.

For ore unloaders . . . blast furnace skip hoists . . . mine hoists . . . and similar installations using motors of large horsepower rating.

FOR OPERATION ON A.C. AND D.C. CIRCUITS

This No. 60 Type WB Brake is designed for large motor applications where high torque is required to stop and hold the load. Its construction includes features such as—(1) a welded steel frame, (2) super-oilite, self-lubricating bearings, (3) case-hardened steel bearing pins, (4) moulded brake blocks, 3/4" thick, which wear down slowly.

The direct current No. 60 Brake is furnished as standard with shunt-wound operating coil and protective resistor. For high speed operation giving fast release and quick set, an automatic relay to allow high releasing current and reduced holding current is used. This results in fast operation, and makes the brake good for any duty.

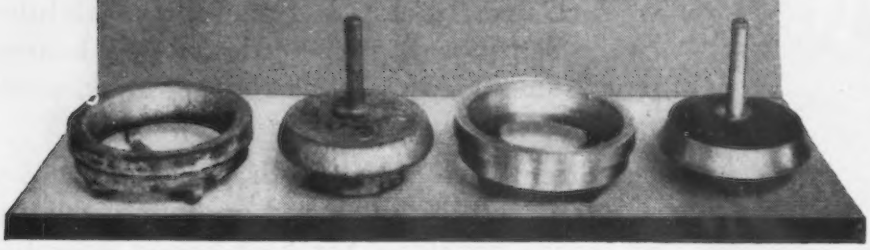


Bulletin 1004-D describes the No. 60 Brake for direct current operation and Bulletin 1006 gives complete information on its use on alternating current circuits.

THE ELECTRIC CONTROLLER & MFG CO.

2698 E. 79th ST. ★ CLEVELAND 4, OHIO

WORN VALVE SEATS AND DISCS MADE GOOD AS NEW BY HARD-FACING



DO YOU NOW HAVE VALVES on high-pressure superheated steam lines that show leaks after only a few weeks' operation? Or that develop deep cuts in the seats involving costly shut-downs?

If so, hard-facing the seats and discs with an alloy of Coast Metals, specially developed for this purpose, will make these parts good as new. Such a protective Coast Metals overlay offers these features:

High resistance to thermal stresses.

Ability to withstand repeated impact at elevated temperatures.

No corrosive effect from superheated steam.

Excellent welding characteristics,—permitting successful application on such base metals as monel, 25.20 chromium nickel, carbon molybdenum steel *without porosity, checks or blemishes.*

Perfect machineability with Carboloy tool,—reducing machining costs often as much as 30%.

Coast Metals Hard-Facing is today's answer also for solving other maintenance problems in the reclamation of worn parts, equipment and machinery. Helpful literature gives full details. Write for this today,—also tell us *your* particular wear-resistance problems.

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COAST METALS *hard-facing weld rods*

MAKE YOUR EQUIPMENT LAST LONGER

Automatic electronic sorters discard oversize or undersize or off-color or defective articles with amazing speed. Electronic devices can inspect the inside of things which the eye cannot see. After the war is over, electronics will give us automatic electric lighting so that when we enter a room, the lights will go on automatically. Air will be made dust free and germ free. Thanks to electronics, airplane travel and navigation will be far safer than ever before."

"The post-war demand for goods in the first two years after victory, will surely exceed the production capacity of the United States," Mr. Brown predicted. "According to estimates by the Philco Corporation, the pent-up demand for radios at the end of 1944 will be between 20 and 25 million units, as compared with the all-time record production of 13,000,000 units in 1941. Demand for refrigerators will exceed 6,000,000 units against production of 3,700,000 in 1941.

Wirebound Boxes Have Prevented Damage To Products in Shipping

• • • **Stimulated by the** Association of American Railroads' announcement that shipping damages for boilers and machinery, other than agricultural, totaled $899,094 in 1943, manufacturers of wirebound boxes are experimenting with new containers to meet the problem.

With the help of several outstanding package laboratories, they are creating containers to fit postwar needs and eliminate damage to products in shipping.

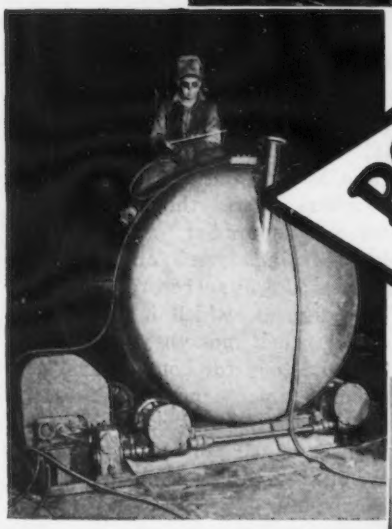
They are consulting with manufacturers of machinery on how they can avoid damage losses in designing, manufacturing and packing their products.

As a result of present experiments and present consultations, the Wirebound Box Manufacturers Association believes it has the answer to the problem of cutting down damage losses in the shipping of machinery. The solution is a flexible, shock-resisting quality to shipping containers.

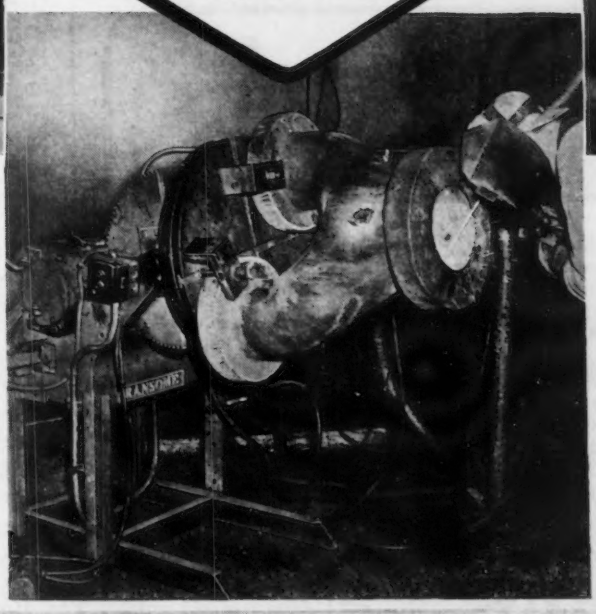
Wirebound boxes and crates are manufactured of light-weight wood, bound and stapled with steel wire. This type of construction gives the box a flexibility that acts as a shock-absorber in taking knocks, and thus cuts down damage to contents.

The new containers of lighter woods designed to have proper size and number of cleats, and the proper number

Ransome POSITIONING EQUIPMENT



POSITION WELDING PAYS



Top Illustration — Large Ransome Positioner handling massive heavy gear case weldments.

Above — Ransome Turning Rolls for hand welding, note convenient remote control on top of tank.

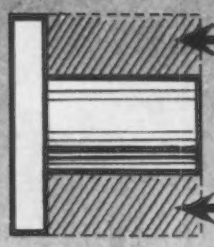
At Right — Ransome Positioner used for welding operation on pipe work in shipyard.

At Extreme Right — Ransome Turning Rolls used with automatic welding of a long tank.

Ransome Positioners are made in standard sizes from 100 lb. hand-operated to 40,000 lb. power-operated * * * available through a nation-wide distributor sales organization * * Write for bulletin 210A

INDUSTRIAL DIVISION Ransome MACHINERY COMPANY
DUNELLEN, NEW JERSEY
SUBSIDIARY OF WORTHINGTON PUMP AND MACHINERY CORPORATION

The bushing of wear-resisting Ampco metal and the steel flange ready for welding.



On flanged bushings, you save all this waste material and machining cost.

The finished job . . . welded . . . machined . . . ready for installation.

Big saving in fabricating frictional parts for machinery . . . with

Ampco-Trode
WELDING ELECTRODES

Welding — the fabricating method which has made such tremendous strides in war production — offers you an economical means of fabricating dissimilar metals, building up bearing surfaces on cheaper base metals, etc.

Illustrated above is an example of the tremendous savings that can be made by welding a bushing of Ampco Metal to a steel flange. Ampco-Trode coated aluminum bronze welding electrodes give you weld metal that is comparable in strength, ductility, and bearing qualities with the various grades of Ampco Metal — the superior aluminum bronze alloy. Any grade of Ampco-Trode, selected for your required physical properties, can be welded to practically all combinations of metals and their alloys.

Perhaps you can apply this modern fabricating method to your product. Investigate — a letter or postcard will place a competent field engineer at your service immediately without charge.

Write today for Ampco-Trode bulletin 61 and further information.

Ampco Metal, Inc.
Department IA-12 Milwaukee 4, Wis.

Ampco Metallurgical Specialties

Ampco Metal — a grade to meet your requirements. . . . Ampcoloy (general industrial bronzes) . . . Special Copper-base-Alloys.

Reg. U.S. Pat. Off.
AMPCO Metal
The Metal without an Equal

Sand Castings . . . Centrifugal Castings . . . Extruded and other Wrought Products . . . Precision-machined Parts . . . Ampco Non-Sparking Safety Tools.

W-3

of wire staples per section for weight and contents of package, are also easier to handle and cheaper to ship because of their lighter weight.

With more than 500,000,000 wirebound boxes used successfully for war shipping during the past four years, the manufacturers are employing the extra skill they have acquired to solve the many shipping problems of peacetime. If the railroads should refuse to allow many previously paid damage claims, they point out, the burden will be on the shipper to make certain his products arrive at their destination safely. Since few shippers can afford to sustain such losses as have been common in the past, and paid for by the railroads, the wirebound box industry considers it an essential for all industries to become conscious of the importance of box and crate engineering.

Industrial Survey Shows Increase In September Earnings

New York

• • • **In the 25 manufacturing** industries surveyed each month by the National Industrial Conference Board, average hourly and weekly earnings of workers were the highest on record in September, while "real" weekly earnings were only 0.2 per cent below the June record.

These figures, which include overtime and other monetary compensation, were $1.080 for hourly earnings, a rise of 0.9 per cent from August, and $49.43 for weekly earnings, also an increase of 0.9 per cent.

Key figures of board's survey for September are:

Hourly earnings average rose 0.9 per cent to $1.080. They were 4.2 per cent higher than in September 1943, and 42.3 per cent above January 1941.

Weekly earnings at $49.43 were 0.9 per cent above those of August. They have risen 4.9 per cent since September 1943, and 61.5 per cent above January 1941.

Real weekly earnings, or dollar weekly earnings adjusted for changes in living costs, were 1.0 per cent higher in September than in August. They were 2.8 per cent above September 1943, and 32.4 per cent above January 1941.

Hours per week remained unchanged at the August level of 45.6. This was 0.3 hr. more than in September 1943, or 0.7 per cent. They were 5.4 hr. or 13.4 per cent longer than in January 1941.

Employment declined 0.9 per cent

SOLVE POST-WAR PRODUCTION PROBLEMS WITH

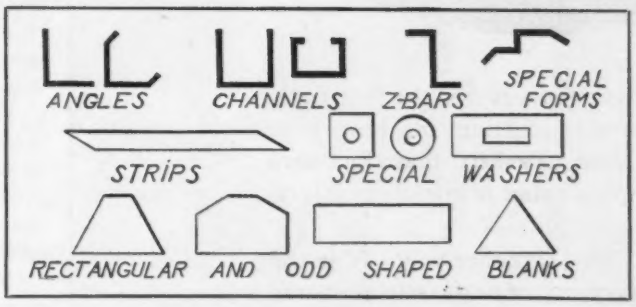
HARRISON SHEET STEEL

FABRICATING
FORMING
FINISHING

20 years of peacetime production coupled with 3 years of accelerated war production has given our company the "know how" to manufacture your peacetime sheet metal parts on a competitive basis. For complete satisfaction call on Harrison.

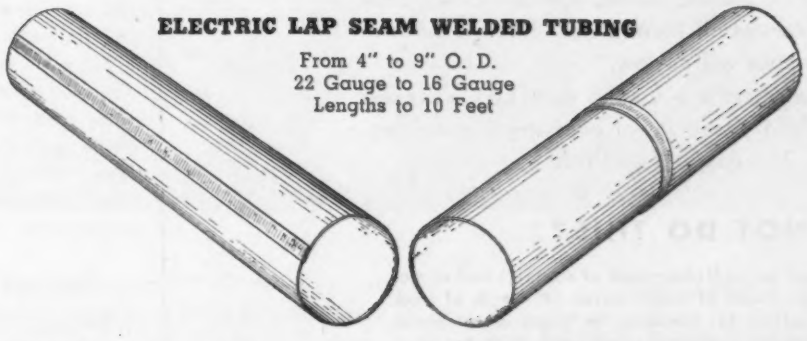
●

Our facilities include equipment not found in average steel fabricating plants — electric seam welders, automatic arc welding heads for continuous line arc welding and a completely conveyorized setup for degreasing, washing, rust-proofing, enameling and baking.



ELECTRIC LAP SEAM WELDED TUBING

From 4" to 9" O. D.
22 Gauge to 16 Gauge
Lengths to 10 Feet



■ PRESS BRAKE FORMING
¼" Capacity — 12 Feet Long

■ PUNCH PRESS OPERATIONS
Blanking and Deep Drawing Operations

■ SPOT WELDING
¼" Plate Capacity

■ SEAM WELDING
Circular and Longitudinal

■ LIGHT WALL TUBING
Manufactured to Your Specifications

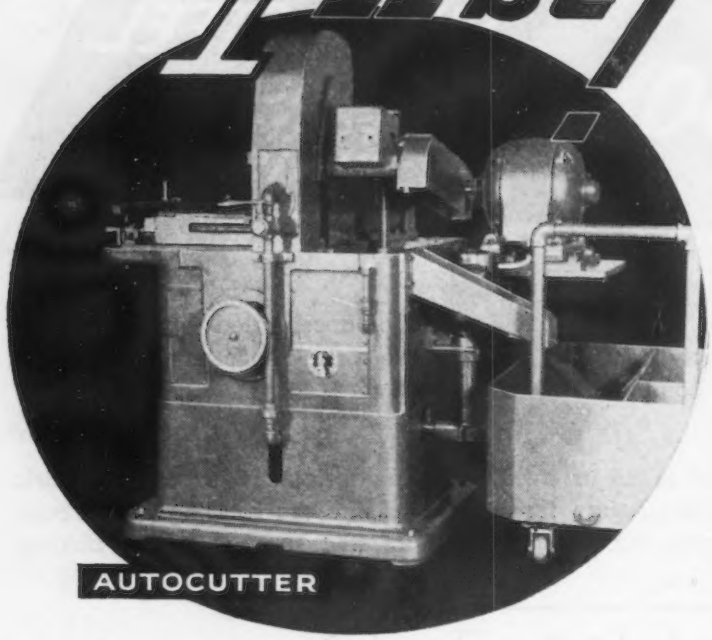
■ ASSEMBLIES
From Radio Base Chassis to Machine Housings

STEEL SHEETS IN STOCK FOR QUICK SERVICE

HARRISON SHEET STEEL COMPANY

4718 WEST FIFTH AVENUE **CHICAGO 44, ILLINOIS**

IT'S A First



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Yes, this CAMPBELL "MODEL 700" is the first *fully automatic* abrasive cutting machine ever built. Coming from CAMPBELL, manufacturers of the most complete range of abrasive cutters, that's big news.

This "700" is "first" another way. It is the opening announcement of CAMPBELL'S post-war program of development, based on wartime improvements all through the line. Other announcements will follow.

Maybe there's a way a CAMPBELL ABRASIVE CUTTER could speed up or economize your production. It's easy to find out.

WHY NOT DO THIS?

Write and tell us (1) the range of sizes, (2) kind of material, (3) length of cutoff pieces, (4) length of stock before cutting, (5) tolerance for length of cut pieces and (6) hourly production requirement. With this information, CAMPBELL engineers can recommend production procedure and work up cost sheets for you.

Campbell

ABRASIVE CUTTING MACHINES

ANDREW C. CAMPBELL DIVISION
BRIDGEPORT • CONNECTICUT

ALSO MAKERS OF A COMPLETE LINE OF NIBBLING MACHINES

ACCO AMERICAN CHAIN & CABLE COMPANY, Inc.
BRIDGEPORT • CONNECTICUT

in September. Since September 1943, employment in the 25 manufacturing industries has declined 8.8 per cent, but it was 24.9 per cent greater than in January 1941.

Man hours declined 0.9 per cent. They averaged 8.2 per cent below those of September 1943, but were 41.9 per cent greater than in January 1941.

Payrolls in September were 0.04 per cent below those of August, and 4.4 per cent below those of September 1943, but were 101.8 per cent greater than in January 1941.

ASME Annual Meeting

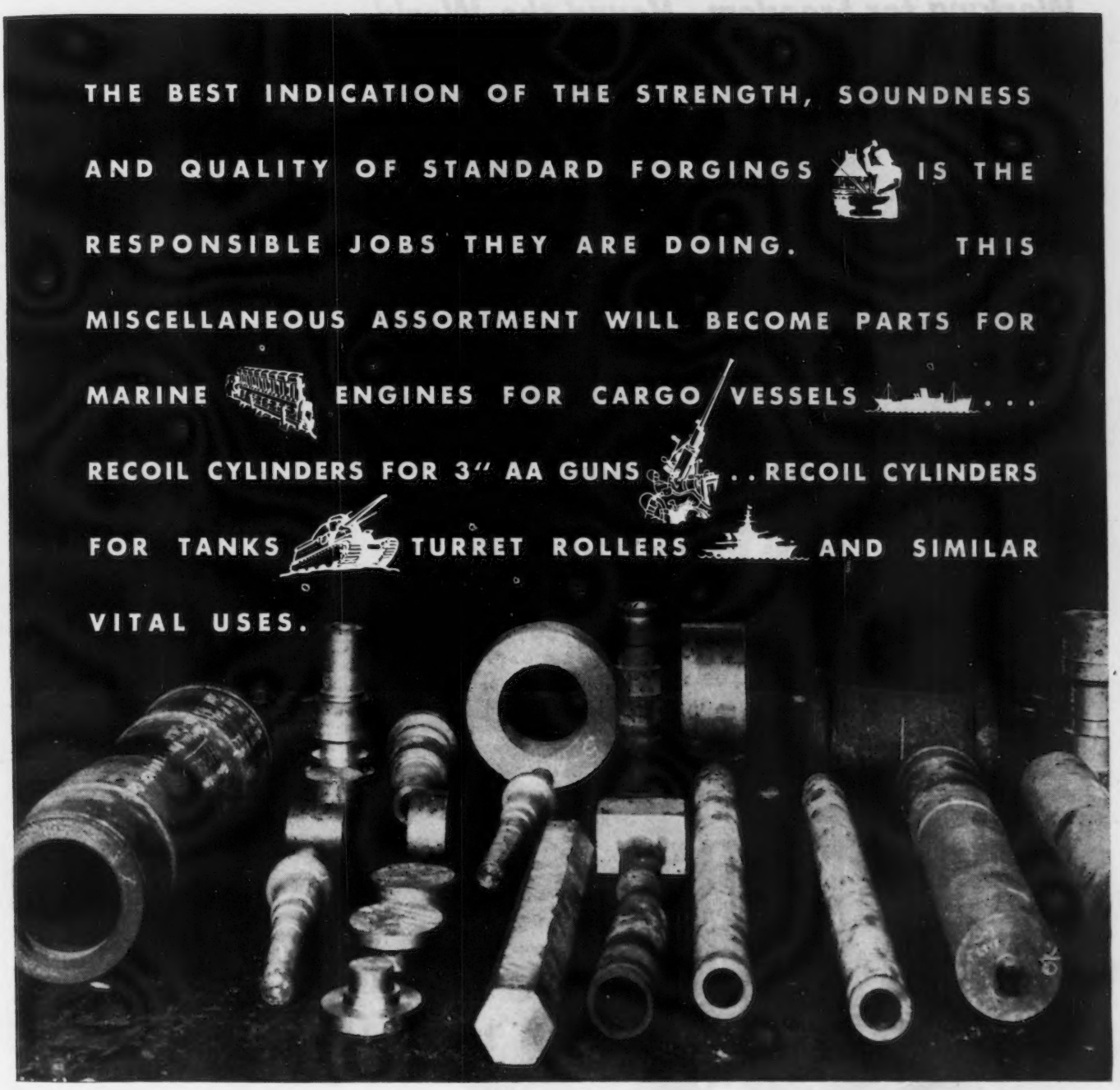
[CONTINUED FROM PAGE 78]

power consumption; smoother operation and less tendency to chatter, and the possibility of using larger rake angles with high speed steel cutters which lessen work of deformation on chip material, lower cutting temperature and lengthen tool life. He warned, however, that down milling requires a backlash eliminator on the feed screw which produces greater wear on screw and nut threads due to the pressure of preload. There is safer operation in up milling due to the separating forces developed between cutter and work, and looseness in moving parts is not detrimental to the cutting action and performance of the machine. In down milling, there is always the danger of the work being dragged under the cutter, with possible injury to cutters, fixtures, machine and the operator. It is therefore important that every precaution be taken in setting up the machine when climb milling.

Reduced Coolant Temperature

Recent tests indicate that an 18 per cent increase in cutting speed for a given tool life may be obtained by cooling the oil, according to data presented by Messrs. O. W. Boston, W. W. Gilbert and R. E. McKee, Department of Metal Processing, University of Michigan. The authors reported on tests made in turning SAE 3140 annealed steel with an 18-4-1 high speed steel bit ground to conventional angles. Tests were run both with sulfo-chlorinated mineral oil containing about 0.6 per cent chlorine and 0.5 per cent chlorine, also with a 1:20 emulsion of standard soluble oil.

For the sulfo-chlorinated mineral oil, the tool life in minutes for a given cutting speed was found to be maximum when the oil is maintained at


THE BEST INDICATION OF THE STRENGTH, SOUNDNESS
AND QUALITY OF STANDARD FORGINGS IS THE
RESPONSIBLE JOBS THEY ARE DOING. THIS
MISCELLANEOUS ASSORTMENT WILL BECOME PARTS FOR
MARINE ENGINES FOR CARGO VESSELS . . .
RECOIL CYLINDERS FOR 3" AA GUNS . . RECOIL CYLINDERS
FOR TANKS TURRET ROLLERS AND SIMILAR
VITAL USES.

Steel Castings with an important job to do, like these, need something *extra* in service qualities. And Standard is equipped to give it.

From the initial charge right to the shipping platform, every operation is carried on under the most precise control, and reflects the experience that started back when Washington was president.

When you have a steel casting that is too big, too difficult, or too particular for ordinary treatment, come to us. In fact, for *any* steel casting needs, the best short-cut to assured satisfaction is to "Standardize on Standard." The Baldwin Locomotive Works, Standard Steel Works Division, Burnham, Pennsylvania, U.S.A. Offices: Philadelphia, New York, Chicago, Washington, Boston, Cleveland, St. Louis, San Francisco, Houston, Pittsburgh.

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Hydraulic presses, Testing equipment, Steel forgings and castings, Diesel-electric locomotives, Diesel engines, Metal plate fabrication, Rolled steel rings, Bronze castings, Heavy machine work, Crane wheels, Bending rolls, Plate planers, Babbitt metal, Alloy iron castings, Briquetting presses.

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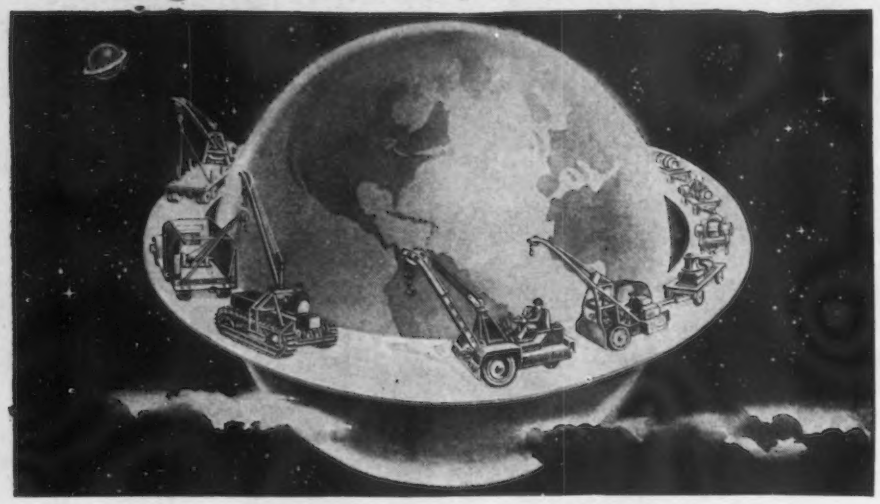
STEEL FORGINGS & CASTINGS

Working for Freedom, 'Round the World



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CAPSTANS • WINCHES • HOISTS
POLE DERRICKS • TRUCK CRANES • CAR PULLERS
KRANE KAR • KRANE KRAWLER • STEVE-KRANE

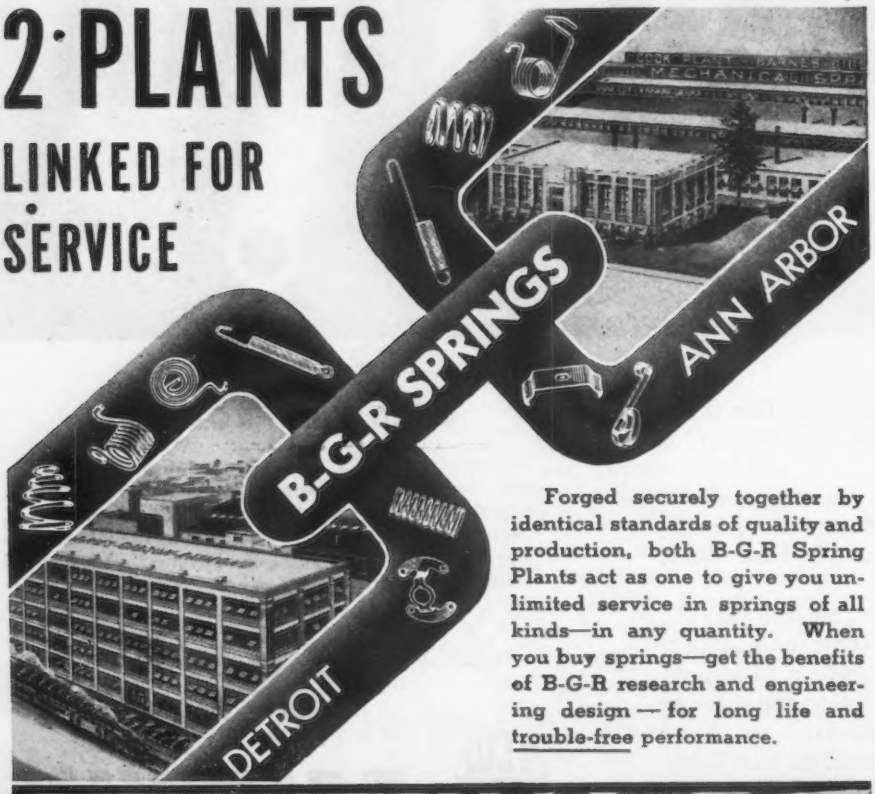
THE ORIGINAL SWING BOOM MOBILE CRANE
WITH FRONT-WHEEL DRIVE AND REAR-WHEEL STEER

2½, 5, AND 10 TON CAPACITIES

KRANE KAR

SILENT HOIST & CRANE CO., 851 63RD ST., BROOKLYN 20, N.Y.

2 PLANTS
LINKED FOR
SERVICE



Forged securely together by identical standards of quality and production, both B-G-R Spring Plants act as one to give you unlimited service in springs of all kinds—in any quantity. When you buy springs—get the benefits of B-G-R research and engineering design — for long life and trouble-free performance.

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TWO PLANTS FOR SPRING SERVICE
DETROIT and ANN ARBOR MICHIGAN
B-G-R PRODUCTS SERVE OUR COUNTRY ON LAND, AT SEA, AND IN THE AIR

a temperature of 75 deg. F. by cooling with a commercial fluid cooler made by the Gray-Mills Co. (See Fig. 4). Apparently the relationship between viscosity and temperature is most effective then. It appears that the high viscosity of the oil at temperatures below 70 deg. is detrimental and that cooling is impaired. At the high temperatures, on the other hand, the viscosity of the oil is low but its ability to carry heat away is reduced. In fact at 150 deg. there is very little difference in tool life as compared when cutting dry.

The most effective operating temperature for the emulsion was found to be between 55 and 70 deg. F., although the falling off in tool life for a given speed was not nearly as marked at the higher temperatues as was the case with the sulfo-chlorinated cutting oil. For a given tool life an increase of 10 per cent in cutting speed can be obtained by cooling the emulsion to these temperatures.

In the discussion, W. H. Oldacre, president, D. A. Stuart Oil Co., warned that there is little basis for the assumption that cooling alone is a panacea. He called attention to the fact that chemical activity of sulphurized oils is increased at the higher temperatures, while cooling has an adverse effect upon visoscity. Furthermore, if the temperature of the coolant is lowered below the dew point, water will get into the oil through condensation.

Crush Dressing Process

New developments made possible by plunge form and thread grinding with the crush dressing process were described by W. Fay Aller, research director, Sheffield Corp. In this method of grinding, a high speed steel crusher is made similar to a circular form tool, carrying the identical shape to be ground in the workpiece. It is slowly fed into the grinding wheel while the latter is rotated at a peripheral speed of 250 to 300 ft. per min. Advantages claimed for this method of wheel dressing over diamond dressing are:

Great saving of time in wheel dressing; considerable increase in number of pieces ground per dressing; reduction in costs due to production of sharper cutting wheels and faster grinding speeds; higher quality work and less spoilage because less heat is generated.

The speaker showed photomicrographs illustrating how in diamond dressing, the sharp diamond in many cases cuts the grains instead of tear-

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ing the grain from the bond, thus creating a dull flat surface. Contrariwise, in crushing, the grains are merely broken away, leaving sharp cutting surfaces. By its very nature, the crushing of grinding wheels is limited to vitreous bonded wheels. Bakelite bonded wheels are too resilient. This subject will be treated in greater detail in a subsequent issue of THE IRON AGE.

Centralized Tool Control

Tool control as practised at the Puget Sound Navy Yard at Bremerton, Wash., was described in a paper presented by Walter E. Ainsworth, master mechanic of the tool shop there. (See "Centralized Grinding for Single Point Tools," THE IRON AGE, Sept. 23, 1943, p. 51.) New features brought qut was the development of an automatic grinder for chisels, which are sharpened by the thousands each day. After being ground to uniform angles, the chisels are given a surface hardening treatment of the cutting edge in an induction hardening machine. Substantial increases in tool life have been obtained. This special machine handles about 300 chisels per hr.

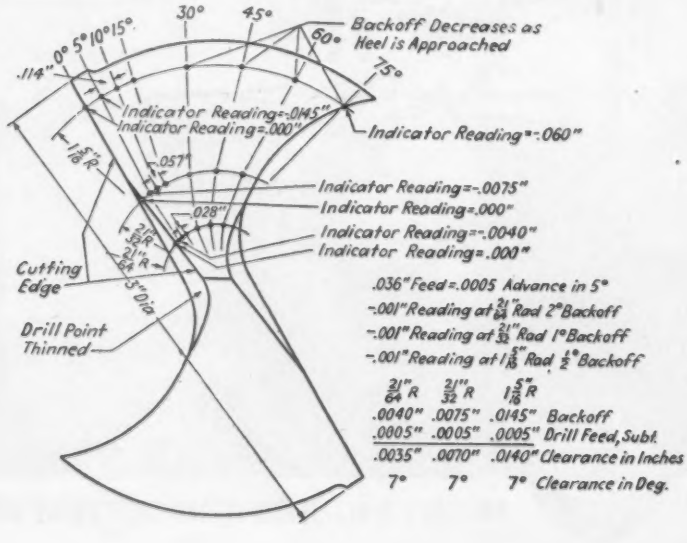
Special equipment has also been developed at this yard for repointing high speed steel drills. In these grinders, the surface behind the cutting edge is ground so that the relief angle increases from the periphery to the center and the clearance angle is uniform (7 deg.) from the periphery to the center (see Fig. 5). In this way a maximum amount of metal is left behind the cutting edge to carry away heat and reinforce the edge. Simultaneously, the chisel point is crowned so that the drill spins concentric when starting. The drill point is thinned to an S-shape which forces the chips at the center of the hole into the flutes of the drill, In drilling armor plate, increases in tool life of 400 per cent have been obtained over conventionally ground drills.

Burring by Tumbling

Removal of sharp edges and corners hardened precision parts is being successfully performed in tumbling barrels or roto-finish machines—all without reducing finished dimensions or risking the development of cracks or scratches which sometimes occur due to the human element at the burr bench or buffing wheel, according to Carl Himmelright, project engineer, Warner & Swasey Co. He was referring to the tumbling of finished aircraft engine parts, in which extremely close tolerances are held during the grinding or finish machining operations. In fact, he said, the use of tumbling barrels makes it unnecessary to hold the exact final inspection limit on surface quality since tumbling with granite chips actually gives an improvement in surface finish.

Reviewing the significance of new methods introduced in manufacturing contract parts, Mr. Himmelright stated that a battery of such tumbling barrels fitted into their postwar view, as compared with extensive hand labor involved in conventional burring. To make proper use of this technique it is necessary to work out the ratio of the number of parts, quantity and size of stones or chips to the size of the barrel being used and the time required to run each load to obtain the removal of sharp edges and surface

FIG. 5—Chart illustrating the manner in which twist drills are checked for amount of relief at the Puget Sound Navy Yard.



finish. The process takes 3-4 hr. Currently surface finishes of 6 to 8 microinch and the breaking of corners with a radius of 0.008 to 0.010 in. are being obtained on aircraft engine parts.

Other methods introduced in war work that have peacetime possibilities, cited by the speaker, included the use of jig borers for precision production work and the adoption of shaving for finishing close tolerance gears that are later hardened. In the latter case, it is necessary to modify the shape of the involute curve and the pitch diameter of the "green" gear to compensate for changes in size resulting from subsequent heat treatment.

To produce gears to these close tolerances takes close control of the heat treatment by developing a precise time cycle for strain relieving, carburizing, annealing and hardening, as well as close control of the modification of the gear shaving cutters. Mr. Himmelright showed by a series of involute checking charts how a deliberately mismachined tooth was pulled back into line by controlled heat treatment. In answer to a question, he admitted that the success of the process largely depended upon the close control of the chemical analysis of aircraft quality steel. Reduction in finishing time of 87 per cent over form grinding of hardened gears more than offsets any premiums on these steels.

Surface Roughness Comparisons

In order to translate root-mean-square values of surface roughness as given by the Profilometer into actual peak-to-valley distances, the RMS values of a variety of abrasive finished steel surfaces were compared with measurements made on photomicrographs of taper sections (see THE IRON AGE, Oct. 26, 1944, p. 76-81). Tests reported by L. P. Tarasov of the Norton Co. research laboratories indicated that for *cylindrically* ground surfaces, the factor can be taken as about 4½, for other types of fixed abrasive finish, as 6 or 7; and for loose abrasive lapped surfaces, as 10. These factors represent the amount by which the RMS value in microinches must be multiplied to obtain the actual peak-to-predominate-valley roughness. They should be doubled to obtain the actual deepest maximum roughness. For ground *flat* surfaces, the factor is 6½; for other types of flat finished surfaces the factors are unchanged.

Summarizing the physical significance of these findings, Mr. Tarasov indicated that for cylindrical surfaces finished to a given Profilometer reading, a ground surface is likely to be smoother in terms of peak-to-valley roughness than a hydro-lapped, sandpapered or superfinished one, while a loose abrasive lapped surface will almost certainly be rougher than a ground of the same RMS value. For flat surfaces finished to the same Profilometer reading, a ground surface will have about the same peak-to-valley roughness as any of the other surfaces except a loose abrasive lapped one, which will probably be rougher. By the same token, for the same Profilometer reading, a ground surface will very likely be smoother when it is cylindrical than when it is flat.

The principle of the mechanical equivalent of heat has been applied in a simple drilling test to determine the relative machinability of various metals. Describing the work done on magnesium alloys at the University of Michigan, Dr. A. O. Schmidt, research engineer, Kearney & Trecker Corp., said the calorimetric method of measuring work done in drilling a hollow sample checked within 1 to 3 per cent of values obtained with a torque and thrust dynamometer.

The test bar is smaller than the drill and has a small hole in the middle so that there is no work done by the chisel point of the drill. Surrounding the workpiece is an insulated container holding 50 cc. of distilled water and covering the bar by ¾ in. Water temperatures are taken at the start of the test and after 1 in. of the bar has been cut. By conversion of the heat energy put in the water, the horsepower per cubic inch per minute can be computed.

The main advantage of this thermal balance method, Dr. Schmidt said, is that it shows even small differences in the cutting properties of various metals. When steel test bars or other materials requiring large cutting forces are used, the amount of metal cut may be one-half or one-quarter of that of magnesium.

A survey of the extent to which industry is employing high speed steel in tip rather than in solid tool form was reported by Frank J. Oliver, technical editor, THE IRON AGE. The full report will be published in a forthcoming issue.

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MACHINE TOOLS

. . . News and Market Activities

Veteran's Survey Indicates Men Not Going Back to Old Jobs

Cleveland

• • • **Machine tool makers** here, mired in a manpower situation seemingly without solution and one that has defied the best approaches of the local WMC, were surveyed recently on the hiring of veterans.

Based on information from 20 of the larger machine tool companies in this area, the survey was in part an effort to determine if the flow of discharged men back into industry offered any possibility of being a partial panacea for the present labor problem.

Generally, the WMC survey seemed to indicate that the current crop of discharged veterans are not precision-skilled, that there is no marked trend to return to former work, that new skills, service-acquired, are not bringing veterans into the machine tool industry to any marked extent, a varying period of occupational readjustment is required and will continue to be required for the younger men.

More than half the employers contacted reported that they have rehired former employees discharged from the army, and while these men have ranged in ability from learners to machine operators, no employer reported the return of highly skilled workers such as tool makers and machinists.

Some of the larger companies are hiring as many as six veterans a month, while some of the smaller concerns have hired only two or three since the beginning of the war. In this regard, it is interesting to note that no employer reported hiring a returned veteran and former employee with additional machine shop skill, gained while in service.

Some personnel men noted that veterans who have had new experience or training in other fields, such as aircraft or electronics, have accepted employment in those fields.

Rumors that key workers had been furloughed from the army to return to the industry were conclusively quashed, since no company reported that more than four such men had been furloughed, and most plants, regardless of the urgency of their contracts, have been unable to secure the release of any, and according to machine tool company representatives, there have been very few requests.

Men in the armed forces are not being released for work in machine tool plants, despite reports of the furloughing of men for foundry work, and since over-age discharge of men 38 and older, the industry has had to be content to take what it could get.

Alert to any opportunity, some of the larger employers here are now utilizing WMC techniques of selective placement of the handicapped, but most of the smaller plants as yet have felt no need for making a special study of jobs for veterans.

All companies surveyed, of course, indicated their willingness to hire veterans who were not former employees, and several plants are now set up to train veterans as apprentice machinists and tool makers under the Veterans Administration training program.

It was further indicated in the WMC survey that most of the companies feel that veterans will adapt themselves more easily to their old jobs with a minimum of special attention, but the present occupational composition of the majority of returned veterans is not in a skilled category.

Cincinnati's experience seems to have been that most of the veterans are not returning to their former jobs in the machine tool industry. It is felt, however, that later on when more men get back and jobs become commensurately scarce, more veterans will take advantage of their re-employment rights. At present, they are shopping around for other jobs.

The industry in Cincinnati held its first meeting recently on the integration of handicapped veterans. This meeting was attended by 450 foremen and the disabled and handicapped veteran and his problems were discussed. Generally, the theme seemed to be that when the veterans get back at work it will require patience on the part of the foremen and a little time on the part of the veterans to get back into the swing of things. Other meetings along this line are planned.

Michigan's general trend reveals a tendency among the younger veterans, those under 28, to find employment other than their former jobs, and the majority of returned veterans in this group are after outdoor employment. Veterans who are 35 years of age or older, and who have been discharged from the armed forces because of over-age, are returning to their former occupations.

In cooperation with the WMC here, the United States Employment Service tries to refer veterans to jobs for which they are best qualified, taking into full account service-acquired skills.

The bottom of Cleveland's labor barrel has long since been scraped by the WMC, and referrals to the machine tool companies these days are only infrequently suited for precision work constituting a rather flat indication that there simply aren't any more people.

Recent program increases, including rockets and heavy shell, and mortar ammunition are rumored to require some 6000 new machines of one sort or another, and with the industry here tightly tied already to these and other urgent programs and a couple of companies loaded with Russian business, contractors shopping in the Cleveland market may find it in something less than a receptive position.

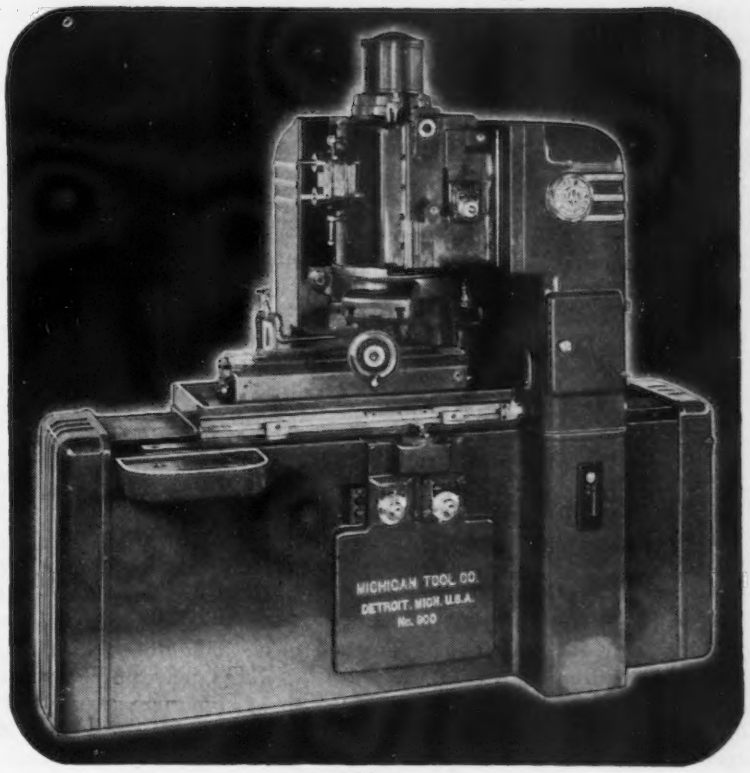
•

Says Machine Tools Can Be Converted Readily

Chicago

• • • **Approximately 90 per cent of** the machine tools produced in the United States since 1939 are, or readily can be converted to, general purpose use, and therefore will be of value after the war, B. A. Mattingly, Chicago regional manager of the surplus war property division of RFC, said here recently. Of approximately one million machine tools manufactured in the United States since 1939, the government owns 500,000 or 600,000, Mattingly said.

THE 4 FREEDOMS OF GEAR FINISHING



1. FREEDOM FROM INACCURACIES

The Michigan 900, uses the basic "rack" to generate gear teeth. It is the most accurate gear finishing machine ever developed. The best proof of this is the inherent quietness of rack-finished gears.

2. FREEDOM FROM DISTORTION

Gear Finishing on a Michigan 900 is a free-cutting and *not* a cold-working process. The machine can also be set to pre-compensate for heat-treat distortion.

3. FREEDOM FROM SHUT-DOWNS

The Michigan 900 Rack Shaving Machine is one of the few machine tools in the world that will machine up to 100,000 units before sharpening tools.

4. FREEDOM FROM COST

The Michigan 900 represents the lowest-cost-per-gear method of gear finishing. Well over 1,000,000 gears have been finished with a single rack. Can be operated by relatively unskilled labor.

For "Post-war", a number of important improvements have now been added to the Michigan 900—the machine that has never been licked.

Ask for a copy of Michigan Tool Company's Gear Finishing Manual (No. GF-43)

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NON-FERROUS METALS

. . . News and Market Activities

Adequate Copper Supply Expected To Permit Authorized Civilian Production

New York

• • • **After another week's study** of the copper supply position as it is affected by the expanded munitions program, producers are still confident that stocks will be adequate. It is believed by the industry that it may not even be necessary for WPB to return to the former conservation basis the essential civilian application on which regulations were recently relaxed.

There is a shortage however in the casting facilities required for the production of brass cakes of the 70 copper—30 zinc Admiralty metal composition. While brass mills are attempting to expand their facilities for the production of cakes, it is probable that this may require a matter of six months or more, at which time the need for the additional facilities may have become less pressing. The adaptation of certain steel mill rolling facilities to the production of brass sheet has assured an adequate supply of this product.

WPB has not taken any action to recall spot authorizations already issued and in the view of some WPB officials there is little likelihood of such action unless the state of the emergency grows more critical. However the granting of new spot authorizations is subject to a still more careful screening and in more than a hundred critical labor areas, in which the Connecticut Valley is represented, new spot authorizations are held up for at least 90 days pending determination of the availability of labor.

•

Aluminum Castings

• • • **A new aluminum sand casting alloy** has been developed by the Eastern Malleable Iron Co. of Naugatuck, Conn., which is said to have high ultimate and yield strengths and reasonable elongation without the necessity for heat treatment. The alloy, identifield as No. 500, is reported to produce sound and machinable castings. The company is not actively marketing these castings at the present time because foundry capacity is fully occupied with war production.

•

Washington

• • • **Aluminum foundries** that do not have special authorization from WPB (AM number authorization) to purchase aluminum ingots for producing castings may purchase up to 10,000 lb. of aluminum during any one month by putting the symbol AM-8000 and the standard certification contained in Priorities Regulation No. 7 on their purchase orders. Those foundries that need more than 10,000 lb. of aluminum ingots a month can apply to the Aluminum Castings Section, Aluminum and Magnesium Division, War Production Board, Washington 25, D. C., for authorization.

WPB said that the granting by this division of permission to use symbol AM-8000 does not exempt any foundry from reporting operations on Form WPB-2685.

•

Rolling Special Alloys

• • • **The rolling mill** of the International Nickel Co., Inc., at Huntington, W. Va., whose equipment is designed especially to handle the strong and tough nickel alloys such as Monel and Inconel, is rolling special alloys containing nickel on a custom basis. At the present time this activity is confined to war production but officials look toward its continuation into the postwar period.

•

Tantalum

• • • **Restrictions on the use** of tantalum have been removed by the WPB. The Mica-Graphite Division, which has been allocating the metal, stated that revocation of the conservation order M156 was made possible through increasing supplies of tantalite ore and a leveling off in demand for tantalum in finished products.

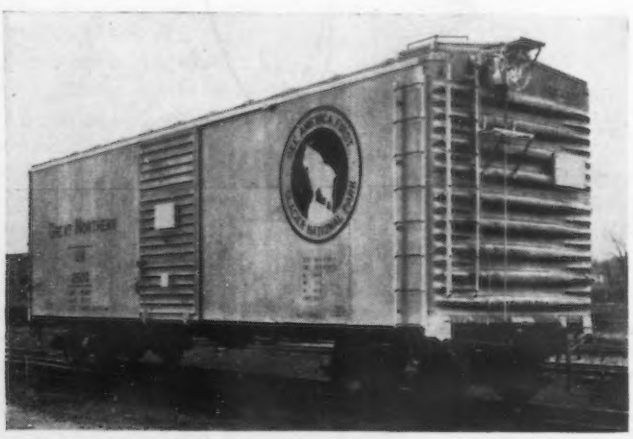
Tantalum is used as a filament in radio tubes and fluoride of tantalum acts as a catalyst in the production of synthetic rubber. Tantalum carbides are also used in cemented carbide cutting tools.

•

Zinc Market Survey

• • • **The great need for reconstruction** in Great Britain after the war has encouraged the Zinc Development Association to prepare and publish a report on applications for zinc in the building industry. As reported by a recent issue of the *Metal Bulletin*, London, great emphasis has been given in the report to the use of galvanized steel or zinc sheet for roofing. Gutters, downspouts and water piping are also reported to represent a good market for these materials, and zinc and die cast zinc alloy castings are being promoted for water fittings, etc.

Products such as perforated zinc sheet and plywood mounted zinc sheet are recommended for screens, ventilators, grills and tabletop coverings.



ALUMINUM EXTERIOR: *Built by the Great Northern Railway's shops, this boxcar is covered with aluminum, and is fitted with some aluminum accessories. It is part of an experimental program in reducing weight of rolling stock.*

Primary Metals

(Cents per lb., unless otherwise noted)

Aluminum, 99+%, del'd. (Min. 10,000 lb.)	15.00
Antimony, American, Laredo, Tex.	14.50
Beryllium copper, 3.75-4.25% Be; dollars per lb. contained Be	$17.00
Cadmium, del'd	90.00
Cobalt, 97-99% (per lb.)	$1.50 to $1.57
Copper, electro, Conn. valley	12.00
Copper, electro, New York	11.75
Copper, lake	12.00
Gold, U. S. Treas., dollars per oz.	$35.00
Indium, 99.5%, dollars per troy oz.	$4.50
Iridium, dollars per troy oz.	$165.00
Lead, St. Louis	6.35
Lead, New York	6.50
Magnesium, 99.9 + %, carlots	20.50
Magnesium, 12-in. sticks, carlots	27.50
Mercury, dollars per 76-lb. flask, f.o.b. New York	$118 to $120.00
Nickel, electro	35.00
Palladium, dollars per troy oz.	$24.00
Platinum, dollars per oz.	$35.00
Silver, open market, New York, cents per oz.	44.75
Tin, Straits, New York	52.00
Zinc, East St. Louis	8.25
Zinc, New York	8.65

Remelted Metals

(Cents per lb. unless otherwise noted)

Aluminum, No. 12 Fdy. (No. 2)	9.00 to 10.00
Aluminum, deoxidizing No. 2, 3, 4	6.00 to 9.50
Brass Ingot	
85-5-5-5 (No. 115)	13.25
88-10-2 (No. 215)	16.75
80-10-10 (No. 305)	16.00
No. 1 Yellow (No. 405)	10.25

Copper, Copper Base Alloys

(Mill base, cents per lb.)

	Extruded Shapes	Rods	Sheets
Copper	20.87	....	20.37
Copper, H.R.	....	17.37	....
Copper drawn	....	18.37	....
Low brass, 80%	....	20.40	20.15
High brass	....	....	19.48
Red brass, 85%	....	20.61	20.36
Naval brass	20.37	19.12	24.50
Brass, free cut	....	15.01	....
Commercial bronze, 90%	....	21.32	21.07
Commercial bronze, 95%	....	21.53	21.28
Manganese bronze	24.00	....	28.00
Phos. bronze, A, B, 5%	....	36.50	36.25
Muntz metal	20.12	18.87	22.75
Everdur, Herculoy, Olympic or equal	....	25.50	26.00
Nickel silver, 5%	....	28.75	26.50
Architect bronze	19.12	....	....

Aluminum

(Cents per lb., subject to extras on gage, size, temper, finish, factor number, etc.)

Tubing: 2 in. O.D. x 0.065 in. wall 2S, 40c. (½H); 52S, 61c. (O); 24S, 67½c. (T).

Plate: 0.250 in. and heavier: 2S and 3S, 21.2c.; 52S, 24.2c.; 61S, 22.8c.; 24S, 24.2c.

Flat Sheet: 0.188 in. thickness: 2S and 3S, 22.7c. a lb.; 52S, 26.2c.; 61S, 24.7c.; 24S, 26.7c.

2000-lb. base for tubing; 30,000-lb. base for plate, flat stock.

Extruded Shapes: "As extruded" temper; 2000-lb. base, 2S and 3S, factor No. 1 to 4, 25.5c.; 14S, factor No. 1 to 4, 35c.; 17S, factor No. 1 to 4, 31c.; 24S, factor No. 1 to 4, 34c.; 53S, factor No. 1 to 4, 28c.; 61S, factor No. 1 to 4, 28½c.

The factor is determined by dividing perimeter of shape by weight per lineal foot.

Wire Rod and Bar: Base price: 17ST and 11ST-3, screw machine stock. Rounds: ¼ in., 28½c. per lb.; ½ in., 26c.; 1 in., 24½c.; 2 in., 23c. Hexagonals; ¼ in., 34½c. per lb.; ½ in., 28½c.; 1 in., 25½c.; 2 in., 25½c. 2S, as fabricated, random or standard lengths, ¼ in., 24c. per lb.; ½ in., 25c.; 1 in., 24c.; 2 in., 23c. 24ST, rectangles and squares, random or standard lengths. 0.093-0.187 in. thick by 1.001-2.000 in. wide, 33c. per lb.; 0.751-1.500 in. thick by 2.001-4.000 in. wide, 29c.; 1.501-2.000 in. thick by 4.001-6.000 in. wide, 27½c.

Magnesium

Sheet, rod, tubes, bars, extruded shapes subject to individual quotations. Metal turnings: 100 lb. or more, 46c. a lb.; 25 to 90 lb., 56c.; less than 25 lb., 66c.

NON-FERROUS SCRAP METAL QUOTATIONS

†*(OPA basic maximum prices, cents per lb., f.o.b. point of shipment, subject to quality, quantity and special preparation premiums—other prices are current quotations)*

Copper, Copper Base Alloys

OPA Group 1†

No. 1 wire, No. 1 heavy copper	9.75
No. 1 tinned copper wire, No. 1 tinned heavy copper	9.75
No. 2 wire, mixed heavy copper	8.75
Copper tuyeres	8.75
Light copper	7.75
Copper borings	9.75
No. 2 copper borings	8.75
Lead covered copper wire, cable	6.00*
Lead covered telephone, power cable	6.04
Insulated copper	5.10*

OPA Group 2†

Bell metal	15.50
High grade bronze gears	13.25
High grade bronze solids	11.50*
Low lead bronze borings	11.50*
Babbitt lined brass bushings	13.00
High lead bronze solids	10.00*
High lead bronze borings	10.00*
Red trolley wheels	10.75
Tinny (phosphor bronze) borings	10.50
Tinny (phosphor bronze) solids	10.50
Copper-nickel solids and borings	9.25
Bronze paper mill wire cloth	9.50
Aluminum bronze solids	9.00
Soft red brass (No. 1 composition)	9.00
Soft red brass borings (No. 1)	9.00
Gilding metal turnings	8.50
Contaminated gilded metal solids	8.50
Unlined standard red car boxes	8.25
Lined standard red car boxes	7.75
Cocks and faucets	7.75
Mixed brass screens	7.75
Red brass breakage	7.50
Old nickel silver solids, borings	6.25
Copper lead solids, borings	6.25
Yellow brass castings	6.25
Automobile radiators	7.00
Zincy bronze borings	8.00
Zincy bronze solids	8.00

OPA Group 3†

Fired rifle shells	8.25
Brass pipe	7.50
Old rolled brass	7.00
Admiralty condenser tubes	7.50
Muntz metal condenser tubes	7.00
Plated brass sheet, pipe reflectors	6.50
Manganese bronze solids	7.25[1]
Manganese bronze solids	6.25[2]
Manganese bronze borings	6.50[1]
Manganese bronze borings	5.50[2]

OPA Group 4†

Refinery brass	4.75*

*Price varies with analysis. [1] Lead content 0.00 to 0.40 per cent. [2] Lead content 0.41 to 1.00 per cent.

Other Copper Alloys!

Briquetted Cartridge Brass Turnings	8.625
Cartridge Brass Turnings, Loose	7.875
Loose Yellow Brass Trimmings	7.875

Aluminum

Plant scrap, segregated

2S solids	8.00
Dural alloys, solids 14, 17, 18, 24S	3.00
25S	3.50
turnings, dry basis	2.50
Low copper alloys 51, 52, 61, 63S solids	5.50
turnings, dry basis	3.50

Plant scrap, mixed

Solids	3.00
Turnings, dry basis	2.00

Obsolete scrap

Pure cable	8.00
Old sheet and utensils	4.50
Old castings and forgings	3.75
Pistons, free of struts	3.50
Pistons, with struts	2.00
Old alloy sheet	3.50

Magnesium

Segregated plant scrap

Pure solids and all other solids, exempt	
Borings and turnings	1.50

Mixed, contaminated plant scrap

Grade 1 solids	3.00
Grade 1 borings and turnings	2.00
Grade 2 solids	2.00
Grade 2 borings and turnings	1.00

Zinc

New zinc clippings, trimmings	6.00
Engravers, lithographers plates	6.00
Old zinc scrap	4.75
Unsweated zinc dross	5.00
Die cast slab	4.50
New die cast scrap	4.45
Radiator grilles, old and new	3.50
Old die cast scrap	3.00

Lead

Deduct 0.55c. a lb. from refined metal basing point prices or soft and hard lead including cable, for f.o.b. point of shipment price.

Nickel

Ni content 98+%, Cu under ½%, 26c. per lb.; 90 to 98% Ni, 26c. per lb. contained Ni.

ELECTROPLATING ANODES AND CHEMICALS

Anodes

(Cents per lb., f.o.b. shipping point)

Copper: Cast, elliptical, 15 in. and longer	25⅛
Electrolytic, full size	22⅞
cut to size	30⅛
Rolled, oval, straight, 15 in. and longer	23¼
Curved	24¼
Brass Cast, 82-20, elliptical, 15 in. and longer	23⅝
Zinc: Cast, 99.99, 16 in. and over	16¼
Nickel: 99% plus, cast	47
Rolled, depolarized	48
Silver: Rolled, 999 fine per Troy (1-9) oz., per oz.	58

Chemicals

(Cents per lb., delivery from New York)

Copper cyanide, tech., 100-lb. bbls. 1-5	5.65
Copper sulphate, 99.5 crystals, bbls.	13.00-13.50
Nickel salts, single, 425-lb. bbls.	34.00
Silver cyanide, 100 oz. lots	40.82-41.125
Sodium cyanide, 96% dom., 100-lb. dms.	0.15
Zinc, cyanide, 100-lb. dms.	33.00
Zinc, sulphate, 89% crystals, bbls.	6.80

SCRAP

. . . News and Market Activities

Open Hearth Scrap Reaches Ceilings

• • • Scrap prices are hitting the ceiling in practically every district this week. In fact because of the elimination of the springboard limitation on transportation costs, the price of open hearth grades shipped from Detroit to Youngstown is higher than the previous Youngstown ceiling. In reverting to ceiling levels, price differentials existing between open hearth grades are once again dispensed with. Blast furnace scrap has followed along with increasing prices and in a few districts has also reached ceilings.

The scrap industry is naturally jubilant over the improved market condition and is predicting a long future of ceiling-priced scrap transactions. But in some quarters it is considered that the increased demand and relatively short supply position of scrap may not continue for an extended period. To justify this, it is pointed out that the impetus toward current increases in price originated in the coverage of short positions by brokers.

Judging by district reports, however, mills seem to be increasing the scale of their purchases and scrap coming into the market seems to have been withheld since the drop from ceiling prices several months ago.

One market factor which may upset all the ideas of the scrap trade is the weather. Should the country experience adverse weather conditions for an extended period there would be little chance of any softening of the market. The course of the war in Europe is another unpredictable factor with the armed forces taking no chance of facing ammunition shortages again it is expected that steel output will remain at high levels until it is certain that Germany has been defeated. On the other hand, any unmistakable evidence that Germany is sagging will probably be immediately reflected in the scrap trends.

•

PITTSBURGH—Scrap prices except in blast furnace grades are again at ceiling. The prices quoted indicate only the ceiling prices and do not include freight that is being paid or brokerage fees. Up to now, there have been no freight charges in excess of $1, which is the limitation that was originally placed on freight but subsequently lifted. Observers here feel that the $1 a ton freight will not be exceeded except in very special cases where a consumer wants a particular shipment of scrap. The indications now are that ceiling prices will hold until after the first of the year, and continue if the weather gets bad. However, if mild weather continues after the first of the year, another price break is likely to occur.

•

DETROIT—Scrap prices stormed upward this week toward ceiling as material-hungry mills came into the thin Detroit market. An order from a Youngstown mill for steel scrap at ceiling price of $17.32 was siphoning all available scrap off yard supplies. This scrap, it should be noted, moves to Youngstown for $3.88 freight plus 50c. commission. Delivered price of $21.70, springboard eliminated, is above the previous ceiling in that district. Simultaneously, blast furnace grades continued their strong movement of recent weeks, advancing from 75c. to $1.75, some of this buying representing coverage on short sales. Laggard cast grades also strengthened. Some low phos sales of quality stock were made at ceiling. Yards in Detroit do not have any considerable supply of scrap on hand, and the first substantial snow of the winter falling over the weekend, will hamper the immediate flow, despite the suddenly enlarged mill demand.

•

ST. LOUIS—Heavy snow in the St. Louis area has further slowed down the movement of scrap iron and given additional strength to the market. Mills' consumption is heavier than receipts and they are expected to come into the market before the end of 1944. Meanwhile it is a dealers' market and they have increased prices to stimulate shipments. Miscellaneous standard section rails are back to the ceiling of $19, a jump of $1.50 to $2. Electric furnace demand upped heavy axle turnings $6. Railroad heavy melting is back to the ceiling price. Other steel items are higher.

•

BUFFALO—Influenced by trends in other sections, open hearth scrap gained $1 a ton this week, with No. 1 heavy melting going to the ceiling. Restoration of the 50c. commission on some business in the top grade hiked the cost to consumers as much as $1.50 to a price of $19.75 a ton. Mills have been slow to follow the latest advance. The leading interest is reported bidding $1 under current quotations and has made no new commitments here so far this month. Covering by brokers has been a factor in sustaining the upturn and some of these transactions are said to have been for the purpose of establishing income tax losses. Relatively greater strength at Pittsburgh and other nearby markets is siphoning off scrap produced in central and eastern New York which ordinarily would come to Buffalo. Cast iron scrap continues in light supply and good demand at maximum prices, but low phosphorus items are slowing down, with consumers occasionally holding up shipments. The lake season's last cargo of scrap—5000 tons from Michigan—will arrive this week.

•

BOSTON—Prices for heavy melting steel and kindred scrap are back on a ceiling basis, and for borings and turnings within striking distance of ceilings. No large tonnages sold the past week, but carlots of No. 1 steel and of mixed Nos. 1 and 2 are moving moderately well and demand for turnings is unquestionably better. Inquiries for foundry scrap for winter backlog purposes are increasing. Actual transactions, however, are limited to truckloads and the aggregate tonnage is not large.

•

PHILADELPHIA—The rise in heavy melting steel scrap prices to ceiling has released scrap which had evidently been accumulating since the first break in ceiling prices. Shipments this week have been heavy. With the return to ceiling, differentials for No. 2 heavy melting scrap and No. 2 bundles have been eliminated. Three mills that have been out of the market for sometime returned last week. Although turnings continue to be plentiful, the strengthened market is reflected here too in higher prices.

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NEW YORK—Prices of all grades except turnings have reached ceilings here and even they are approaching that level rapidly. The volume of business has expanded considerably as compared with recent weeks and at least one broker looks for continuation of this level of market activity until the European war comes to its conclusion. With prices at ceilings again, differentials between open hearth grades haye been wiped out.

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BIRMINGHAM—Almost over night a very weak scrap market here has developed into a very strong one with price advances for some grades going as high as $2.50 per ton. Mills in the district are back in the market and the trade here expects the upward price trend toward ceilings to continue.

•

CHICAGO—Pressure of out of district sales operating in conjunction with abolition of maximum springboards has forced the price at which all better open hearth grades can be purchased to ceiling. So far Chicago district mills have shown little enthusiasm for purchasing at the advanced scale, although one local sale of No. one heavy melting at ceiling plus commission was recorded. Dealers have been heartened by heavy snow fall into withholding offerings of secondary grades and further advances may be in prospect. Blast furnace grades have recorded only moderate advances.

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CLEVELAND—Similar to conditions in other areas prices here have risen in most instances to the ceiling. That they may stay there for awhile is indicated in the shortage of No. 1 open hearth scrap also the adverse winter weather with snow in areas around this center will mean a slowup in collections and movement from yards.

Going prices as obtained in the trade by IRON AGE editors, based on representative tonnages (for ceiling prices see O. P. A. schedule No. 4). Where ceiling prices are quoted they do not include brokerage fee or adjusted freight.

PITTSBURGH

Per gross ton delivered to consumer:

No. 1 hvy. melting	$20.00
RR. hvy. melting	21.00
No. 2 hvy. melting	$19.00 to 19.50
RR. scrap rails	21.50
Rails 3 ft. and under	23.50
No. 1 comp'd sheets	20.00
Hand bdld. new shts.	19.00 to 19.50
Hvy. axle turn.	16.50 to 17.00
Hvy. steel forge turn.	16.50 to 17.00
Mach. shop turn.	10.75 to 11.25
Short shov. turn.	15.50 to 16.00
Mixed bor. and turn.	10.75 to 11.25
Cast iron borings	13.50 to 14.00
Hvy. break. cast	16.50 plus frt.
No. 1 cupola	20.00 plus frt.
RR. knuck. and coup.	*24.50
RR. coil springs	24.50
Rail leaf springs	24.50
Rolled steel wheels	24.50
Low phos. billet crops	24.45
Low phos.	22.50
RR. malleable	22.00 plus frt.

CHICAGO

Per gross ton delivered to consumer:

No. 1 hvy. melting	$18.75
No. 2 hvy. melting	18.75
No. 1 bundles	18.75
No. 2 dealers' bndls.	18.25
Galv. bundles (No. 3)	$14.25 to 14.75
Mach. Shop turn.	9.50 to 10.00
Short shoveling turn.	9.75 to 10.25
Cast iron borings	9.75 to 10.25
Mix. bor. & short turn.	9.75 to 10.25
Low phos. hvy. forge	23.75
Low phos. plates	21.25
No. 1 RR hvy. melting	19.25 to 19.75
Reroll rails	22.25
Cut rails, 3 ft. and under	22.25
Locomotive tires, cut	22.25 to 22.75
Cut bolsters & side frames	19.75 to 20.25
Angles & splice bars	22.25
No. 3 steel wheels	20.75 to 21.25
Couplers & Knuckles	21.50 to 22.00
Miscellaneous rails	20.25
Agricul. malleable	21.00 to 21.50
RR. malleable	22.00
St'dard stl. car axles	24.50 to 25.00
FOB shipping point	
No. 1 mach. cast	20.00
No. 1 agricul. cast	20.00
Cast iron car wheels	20.00
Hvy. breakable cast	16.50
RR. grate bars	15.25
Brake shoes	15.25
Stove plate	19.00
Clean auto cast	20.00

CINCINNATI

Per gross ton delivered to consumer:

No. 1 hvy. melting	$16.50 to $17.00
No. 2 hvy. melting	15.50 to 16.00
No. 1 bundles	16.50 to 17.00
No. 2 bundles	14.50 to 15.00
Mach. shop turn.	5.50 to 6.00
Shoveling turn.	7.00 to 7.50
Cast iron borings	7.50 to 8.00
Mixed bor. & turn.	6.00 to 6.50
No. 1 cupola cast	21.00
Hvy. breakable cast	16.50
Low phos. plate	20.00 to 21.00
Scrap rails	20.00 to 21.00
Stove plate	15.50 to 16.00

BOSTON

Dealers' buying prices per gross ton, f.o.b. cars

No. 1 hvy. melting	$15.05
No. 2 hvy. melting	15.05
Busheling	15.05
No. 1 and 2 bundles	15.05
Turnings, shovelings	$8.50 to 9.50
Turnings, regular	6.50 to 7.50
Mixed bor. & turn.	6.50 to 7.50
Clean cast, chem. bor.	13.06 to 14.15
Delivered to fdry. per gr. ton	
Breakable cast	21.57 to 21.87
Stove plate	20.00 to 23.51
Machinery cast, truck	21.00 to 23.51

DETROIT

Per gross ton, brokers' buying prices:

No. 1 hvy. melting	$17.32
No. 2 hvy. melting	17.32
No. 1 bundles	17.32
New busheling	17.32
Mach. shop turn.	$7.75 to 8.25
Short shov. turn.	10.75 to 11.25
Cast iron borings	10.25 to 10.75
Mixed bor. & turn.	7.75 to 8.25
No. 1 cupola cast	20.00
Charging box cast	15.50 to 16.50
Hvy. breakable cast	14.00 to 15.00
Stove plate	18.50 to 19.00
Flashings	17.32
Low phos. plate	17.50 to 19.82
Automotive cast	20.00

PHILADELPHIA

Per gross ton delivered to consumer:

No. 1 hvy. melting	$18.75
No. 2 hvy. melting	18.75
No. 2 bundles	18.75
Mach. shop turn.	$12.00 to 12.50
Shoveling turn.	12.50 to 13.00
Cast iron borings	12.50 to 13.00
Mixed bor. & turn.	12.00 to 12.50
No. 1 cupola cast	*20.00
Hvy. breakable cast	*16.50
Cast, charging box	*19.00
Hvy. axle, forge turn.	17.00 to 17.50
Low phos. plate	21.25
Low phos. punchings	21.25
Billet crops	21.00 to 21.25
RR. steel wheels	23.25
RR. coil springs	23.25
RR. malleable	*22.00

*F.o.b. shipping point.

ST. LOUIS

Per gross ton delivered to consumer:

Hvy. melting	$16.50 to $17.00
No. 1 locomot'e tires	17.50 to 18.00
Misc. stand. sec. rails	19.00
Railroad springs	19.50 to 20.00
Bundled sheets	13.00 to 13.50
Heavy axle turn.	14.00 to 14.50
Machine shop turns.	7.50 to 8.00
Rerolling rails	21.00
Steel car axles	21.00 to 21.50
Steel rails under 3 ft.	21.50
Steel angle bars	18.50 to 19.00
Cast iron car wheels	20.00
No. 1 machinery cast	20.00
Railroad malleable	20.00 to 20.50
Breakable cast	16.50
Stove plate	17.00
Grate bars	15.25
Brake shoes	15.25

Note: Cast grades f.o.b. Shipping Point.

BIRMINGHAM

Per gross ton delivered to consumer:

No. 1 hvy. melting	$16.00 to $16.50
No. 2 hvy. melting	16.00 to 16.50
No. 2 bundles	15.00 to 15.50
No. 1 busheling	13.50 to 14.00
Scrap rails	17.00 to 17.50
Rails for rerolling	19.00 to 19.50
Rails 3 ft. & under	19.00 to 19.50
Angles & splice bars	18.00 to 18.50
Long turn.	5.50 to 6.00
Cast iron borings	8.50 to 9.00
Steel axles	16.00 to 16.50
Stove plate	17.00 to 17.50
Bar crops and plate	17.00 to 17.50
Structural and plate	17.00 to 17.50
No. 1 cast	20.00 to 21.00
Cast iron carwheels	13.50 to 14.00

YOUNGSTOWN

Per gross ton delivered to consumer:

No. 1 hvy. melting	$20.00
No. 2 hvy. melting	$19.00 to 19.50
Low phos. plate	22.00 to 22.50
No. 1 busheling	20.00
Hydraulic bundles	20.00
Mach. shop turn.	13.50 to 14.00
Short shovel. turn.	16.00 to 16.50
Cast iron borings	15.00 to 15.50

NEW YORK

Dealers' buying prices, per gross ton, on cars:

No. 1 hvy. melting	$15.33
No. 2 hvy. melting	15.33
Hyd. comp. black bundles	15.33
Hyd. comp. galv. bundles	13.33
Hvy. breakable cast	16.50
Charging box cast	19.00
No. 1 cupola cast	20.00
Clean auto cast	20.00
Unstrip. motor blks.	17.50
Stove plate	19.00
Clean chem. cast bor.	14.33
Mach. shop turn.	$7.00 to 8.00
Mixed bor. & turn.	7.00 to 8.00

BUFFALO

Per gross ton delivered to consumer:

No. 1 hvy. melting	$19.25
No. 1 bundles	$16.50 to 17.00
No. 2 bundles	15.50 to 16.00
No. 2 hvy. melting	16.50 to 17.00
Mach. shop turn.	10.00 to 10.50
Shoveling turn.	12.00 to 12.50
Cast iron borings	11.00 to 11.50
Mixed bor. & turn.	11.00 to 11.50
No. 1 cupola cast	20.00 plus frt.
Stove plate	19.00 plus frt.
Low phos. plate	21.75
Scrap rails	20.00 to 20.25
Rails 3 ft. & under	22.75
RR. steel wheels	23.75
Cast iron car wheels	30.00
RR. coil & leaf sprgs.	23.75
RR. knuckles & coup.	23.75
RR. malleable	22.00
No. 1 busheling	16.50 to 17.00

CLEVELAND

Per gross ton delivered to consumer:

No. 1 hvy. melting	$19.50
No. 2 hvy. melting	19.50
Compressed sheet stl.	19.50
Drop forge flashings	$18.50 to 19.00
No. 2 bundles	18.50
Mach. shop turn.	12.00 to 12.50
Short shovel.	14.00 to 14.50
No. 1 busheling	19.50
Steel axle turn.	17.50 to 18.00
Low phos. billet and bloom crops	23.66 plus frt.
Cast iron borings	13.50 to 14.00
Mixed bor. & turn.	13.50 to 14.00
No. 2 busheling	16.00 to 16.50
No. 1 machine cast	20.00 plus frt.
Railroad cast	20.00 plus frt.
Railroad grate bars	15.25 plus frt.
Stove plate	19.00 plus frt.
RR. hvy. melting	20.50
Rails 3 ft. & under	23.00
Rails 18 in. & under	24.25
Rails for rerolling	23.00
Railroad malleable	22.00 plus frt.
Elec. furnace punch.	21.50 to 22.00

SAN FRANCISCO

Per gross ton delivered to consumer:

No. 1 hvy. melting	$16.00 to $16.75
RR. hvy. melting	16.00 to 16.75
No. 2 hvy. melting	15.00 to 15.75
No. 2 bales	14.00 to 14.75
No. 3 bales	10.00 to 10.75
Mach. shop turn.	7.00
Elec. furn 1 ft., under	16.00 to 17.50
No. 1 cupola cast	20.00 to 22.00

LOS ANGELES

Per gross ton delivered to consumer:

No. 1 hvy. melting	$14.00 to $15.00
No. 2 hvy. melting	13.00 to 14.00
No. 2 bales	12.00 to 13.00
No. 3 bales	10.00 to 10.50
Mach. shop turn.	5.00
No. 1 cupola cast	20.00 plus frt.

SEATTLE

Per gross ton delivered to consumer:

No. 1 hvy. melting	$13.50
RR. hvy. melting	13.50
No. 3 bundles	11.50
Elec. furn. 1 ft., und.	$16.00 to 17.00
No. 1 cupola cast	20.00

Comparison of Prices . . .

Advances Over Past Week in **Heavy Type**; Declines in *Italics*. (Prices Are F.O.B. Major Basing Points)

(Cents Per Lb.)	Dec. 12, 1944	Dec. 5, 1944	Nov. 7, 1944	Dec. 14, 1943
Flat Rolled Steel:				
Hot rolled sheets	2.10	2.10	2.10	2.10
Cold rolled sheets	3.05	3.05	3.05	3.05
Galvanized sheets (24 ga.)	3.50	3.50	3.50	3.50
Hot rolled strip	2.10	2.10	2.10	2.10
Cold rolled strip	2.80	2.80	2.80	2.80
Plates	2.10	2.10	2.10	2.10
Plates, wrought iron	3.80	3.80	3.80	3.80
Stain's c.r. strip (No. 302)	28.00	28.00	28.00	28.00
Tin and Terne Plate: (Dollars Per Base Box)				
Tin plate, standard cokes	$5.00	$5.00	$5.00	$5.00
Tin plate, electrolytic	4.50	4.50	4.50	4.50
Special coated mfg. ternes	4.30	4.30	4.30	4.30
Bars and Shapes: (Cents Per Lb.)				
Merchant bars	2.15	2.15	2.15	2.15
Cold finished bars	2.65	2.65	2.65	2.65
Alloy bars	2.70	2.70	2.70	2.70
Structural shapes	2.10	2.10	2.10	2.10
Stainless bars (No. 302)	24.00	24.00	24.00	24.00
Wrought iron bars	4.40	4.40	4.40	4.40
Wire and Wire Products: (Cents Per Lb.)				
Plain wire	2.60	2.60	2.60	2.60
Wire nails	2.55	2.55	2.55	2.55
Rails: (Dollars Per Gross Ton)				
Heavy rails	$40.00	$40.00	$40.00	$40.00
Light rails	40.00	40.00	40.00	40.00
Semi-Finished Steel: (Dollars Per Gross Ton)				
Rerolling billets	$34.00	$34.00	$34.00	$34.00
Sheet bars	34.00	34.00	34.00	34.00
Slabs, rerolling	34.00	34.00	34.00	34.00
Forging billets	40.00	40.00	40.00	40.00
Alloy blooms, billets, slabs	54.00	54.00	54.00	54.00
Wire Rods and Skelp: (Cents Per Lb.)				
Wire rods	2.00	2.00	2.00	2.00
Skelp	1.90	1.90	1.90	1.90

(Per Gross Ton)	Dec. 12, 1944	Dec. 5, 1944	Nov. 7, 1944	Dec. 14, 1943
Pig Iron:				
No. 2 fdy., Philadelphia	$25.84	$25.84	$25.84	$25.84
No. 2, Valley furnace	24.00	24.00	24.00	24.00
No. 2, Southern Cin'ti	25.11	25.11	25.11	24.68
No. 2, Birmingham	20.38	20.38	20.38	20.38
No. 2, foundry, Chicago†	24.00	24.00	24.00	24.00
Basic, del'd eastern Pa.	25.34	25.34	25.34	25.39
Basic, Valley furnace	23.50	23.50	23.50	23.50
Malleable, Chicago†	24.00	24.00	24.00	24.00
Malleable, Valley	24.00	24.00	24.00	24.00
L. S. charcoal, Chicago	37.34	37.34	37.34	31.34
Ferromanganese‡	135.00	135.00	135.00	135.00

†The switching charge for delivery to foundries in the Chicago district is 60c. per ton.
‡For carlots at seaboard.

(Per Gross Ton)				
Scrap:				
Heavy melt'g steel, P'gh.	$20.00	$19.75	$15.75	$20.00
Heavy melt'g steel, Phila.	18.75	17.75	15.50	18.75
Heavy melt'g steel, Ch'go	18.75	18.50	16.50	18.75
No. 1 hy. comp. sheet, Det.	17.32	13.75	11.75	17.85
Low phos. plate, Youngs'n	22.25	19.75	17.75	22.50
No. 1 cast, Pittsburgh	20.00*	20.00*	20.00*	20.00
No. 1 cast, Philadelphia	20.00*	20.00*	20.00*	20.00
No. 1 cast, Chicago	20.00*	20.00*	20.00*	20.00

*F.o.b. shipping point.

(Per Net Ton at Oven)				
Coke, Connellsville:				
Furnace coke, prompt	$7.00	$7.00	$7.00	$6.50
Foundry coke, prompt	8.25	8.25	8.25	7.50

(Cents Per Lb. to Large Buyers)				
Non-Ferrous Metals:				
Copper, electro., Conn	12.00	12.00	12.00	12.00
Copper, Lake	12.00	12.00	12.00	12.00
Tin (Straits), New York	52.00	52.00	52.00	52.00
Zinc, East St. Louis	8.25	8.25	8.25	8.25
Lead, St. Louis	6.35	6.35	6.35	6.35
Aluminum, Virgin, del'd.	15.00	15.00	15.00	15.00
Nickel, electrolytic	35.00	35.00	35.00	35.00
Magnesium, ingot	20.50	20.50	20.50	20.50
Antimony, Laredo, Tex.	14.50	14.50	14.50	14.50

The various basing points for finished and semi-finished steel are listed in the detailed price table, pages 169-177.

Composite Prices . . .

Starting with the issue of April 22, 1943, the weighted finished steel price index was revised for the years 1941, 1942 and 1943. See explanation of the change on page 90 of the April 22, 1943 issue.

	FINISHED STEEL	PIG IRON	SCRAP STEEL
December 12, 1944	2.30837c. a Lb.	$23.61 a Gross Ton	$19.17 a Gross Ton
One week ago	2.30837c. a Lb.	$23.61 a Gross Ton	$18.67 a Gross Ton
One month ago	2.30837c. a Lb.	$23.61 a Gross Ton	$15.92 a Gross Ton
One year ago	2.25513c. a Lb.	$23.61 a Gross Ton	$19.17 a Gross Ton

	HIGH	LOW	HIGH	LOW	LOW	HIGH
1944	2.30837c., Sept. 5	2.272349c., Jan. 4				
1943	2.25513c.,	2.25513c.,	$23.61	$23.61	$19.17	$19.17
1942	2.26190c.,	2.26190c.,	23.61	23.61	19.17	19.17
1941	2.43078c.,	2.43078c.,	$23.61, Mar. 20	$23.45, Jan. 2	$19.17, Apr. 10	$22.00, Jan. 7
1940	2.30467c., Jan. 2	2.24107c., Apr. 16	23.45, Dec. 23	22.61, Jan. 2	16.04, Apr. 9	21.83, Dec. 30
1939	2.35367c., Jan. 3	2.26689c., May 16	22.61, Sept. 19	20.61, Sept. 12	14.08, May 16	22.50, Oct. 3
1938	2.58414c., Jan. 4	2.27207c., Oct. 18	23.25, June 21	19.61, July 6	11.00, June 7	15.00, Nov. 22
1937	2.58414c., Mar. 9	2.32263c., Jan. 4	23.25, Mar. 9	20.25, Feb. 16	12.67, June 8	21.92, Mar. 30
1936	2.32263c., Dec. 28	2.05200c., Mar. 10	19.74, Nov. 24	18.73, Aug. 11	12.67, June 9	17.75, Dec. 21
1935	2.07642c., Oct. 1	2.06492c., Jan. 8	18.84, Nov. 5	17.83, May 14	10.33, Apr. 29	13.42, Dec. 10
1934	2.15367c., Apr. 24	1.95757c., Jan. 2	17.90, May 1	16.90, Jan. 27	9.50, Sept. 25	13.00, Mar. 13
1933	1.95578c., Oct. 3	1.75836c., May 2	16.90, Dec. 5	13.56, Jan. 3	6.75, Jan. 3	12.25, Aug. 8
1932	1.89196c., July 5	1.83901c., Mar. 1	14.81, Jan. 5	13.56, Dec. 6	6.43, July 5	8.50, Jan. 12
1931	1.99626c., Jan. 13	1.86586c., Dec. 29	15.90, Jan. 6	14.79, Dec. 15	8.50, Dec. 29	11.33, Jan. 6
1930	2.25488c., Jan. 7	1.97319c., Dec. 9	18.21, Jan. 7	15.90, Dec. 16	11.25, Dec. 9	15.00, Feb. 18
1929	2.31773c., May 28	2.26498c., Oct. 29	18.71, May 14	18.21, Dec. 17	14.08, Dec. 3	17.58, Jan. 29

Weighted index based on steel bars, shapes, plates, wire, rails, black pipe, hot and cold-rolled sheets and strip, representing 78 per cent of the United States output. Index recapitulated in Aug. 28, 1941, issue.

Based on averages for basic iron at Valley furnaces and foundry iron at Chicago, Philadelphia, Buffalo, Valley and Southern iron at Cincinnati.

Based on No. 1 heavy melting steel scrap quotations to consumers at Pittsburgh, Philadelphia and Chicago.

Prices of Finished Iron and Steel . . .

Steel prices shown here are f.o.b. basing points, in cents per lb., unless otherwise indicated. Extras apply. Delivered prices do not reflect 3% tax on freight. (1) Mill run sheet, 0.10¢ per lb. under base; primes 0.25¢ above base. (2) Unassorted 8-lb. coating. (3) Widths up to 12-in. (4) 0.25 carbon and less. (5) Applies to certain width and length limitations. (6) For merchant trade. (7) For straight length material only from producer to consumer. Discount of 25¢ per 100 lb. to fabricators. (8) Also shafting. For quantities of 20,000 to 29,999 lb. (9) Carload lot in manufacturing trade. (10) Prices do not apply if rail and water is not used. (12) Boxed. (13) Portland and Seattle price, San Francisco 2.50¢. (14) This base price for annealed, bright finish wires, commercial spring wire.

Basing Point → / Product ↓	Pittsburgh	Chicago	Gary	Cleveland	Birmingham	Buffalo	Youngstown	Sparrows Point	Granite City	Middletown, Ohio	Gulf Ports, Cars	Pacific Ports, Cars[13]	DELIVERED TO Detroit	New York	Philadelphia
Hot Rolled Sheets	2.10¢	2.10¢	2.10¢	2.10¢	2.10¢	2.10¢	2.10¢	2.10¢	2.20¢	2.10¢		2.65¢	2.20¢	2.34¢	2.27¢
Cold Rolled Sheets[1]	3.05¢	3.05¢	3.05¢	3.05¢		3.05¢	3.05¢		3.15¢	3.05¢		3.70¢	3.15¢	3.39¢	3.37¢
Galvanized Sheets (24 gage)	3.50¢	3.50¢	3.50¢		3.50¢	3.50¢	3.50¢	3.50¢	3.60¢	3.50¢		4.05¢		3.74¢	3.67¢
Enameling Sheets (20 gage)	3.35¢	3.35¢	3.35¢	3.35¢			3.35¢		3.45¢	3.35¢		4.00¢	3.45¢	3.71¢	3.67¢
Long Ternes[2]	3.80¢	3.80¢	3.80¢									4.55¢		4.16¢	4.12¢
Hot Rolled Strip[3]	2.10¢	2.10¢	2.10¢	2.10¢	2.10¢		2.10¢			2.10¢		2.75¢	2.20¢	2.46¢	
Cold Rolled Strip[4]	2.80¢	2.90¢		2.80¢			2.80¢	(Worcester = 3.00¢)					2.90¢	3.16¢	
Cooperage Stock Strip	2.20¢	2.20¢			2.20¢		2.20¢							2.56¢	
Commodity C-R Strip	2.95¢	3.05¢		2.95¢			2.95¢	(Worcester = 3.35¢)					3.05¢	3.31¢	
Coke Tin Plate, Base Box	$5.00	$5.00	$5.00						$5.10					5.36¢	5.32¢
.25 / .50 / .75 Electro Tin Plate, Box	$4.35 / $4.50 / $4.65	$4.35 / $4.50	$4.35 / $4.50 / $4.65						$4.60 / $4.75						
Black Plate (29 gage)[5]	3.05¢	3.05¢	3.05¢						3.15¢			4.05¢[13]			3.37¢
Mfg. Ternes, Special Box	$4.30	$4.30	$4.30						$4.40						
Carbon Steel Bars	2.15¢	2.15¢	2.15¢	2.15¢	2.15¢	2.15¢		(Duluth = 2.25¢)			2.50¢	2.80¢	2.25¢	2.49¢	2.47¢
Rail Steel Bars[6]	2.15¢	2.15¢	2.15¢	2.15¢	2.15¢	2.15¢					2.50¢	2.80¢			
Reinforcing (Billet) Bars[7]	2.15¢	2.15¢	2.15¢	2.15¢	2.15¢	2.15¢	2.15¢	2.15¢			2.50¢	2.55¢[13]	2.25¢	2.39¢	
Reinforcing (Rail) Bars[7]	2.15¢	2.15¢	2.15¢	2.15¢	2.15¢	2.15¢	2.15¢				2.50¢	c2.55¢[13]	2.25¢		2.47¢
Cold Finished Bars[8]	2.65¢	2.65¢	2.65¢	2.65¢		2.65¢		(Detroit = 2.70¢)			(Toledo = 2.80¢)			2.99¢	2.97¢
Alloy Bars, Hot Rolled	2.70¢	2.70¢				2.70¢		(Bethlehem, Massillon, Canton = 2.70¢)					2.80¢		
Alloy Bars, Cold Drawn	3.35¢	3.35¢	3.35¢	3.35¢		3.35¢							3.45¢		
Carbon Steel Plates	2.10¢	2.10¢	2.10¢	2.10¢	2.10¢		2.10¢	(Coatesville and Claymont = 2.10¢) 2.10¢	2.35¢		2.45¢	2.65¢	2.32¢	2.29¢	2.15¢
Floor Plates	3.35¢	3.35¢									3.70¢	4.00¢		3.71¢	3.67¢
Alloy Plates	3.50¢	3.50¢			(Coatesville = 3.50¢)						3.95¢	4.15¢		3.70¢	3.59¢
Structural Shapes	2.10¢	2.10¢	2.10¢		2.10¢	2.10¢		(Bethlehem = 2.10¢)			2.45¢	2.75¢		2.27¢	2.215¢
SPRING STEEL, C-R 0.26 to 0.50 Carbon	2.80¢			2.80¢			(Worcester = 3.00¢)								
0.51 to 0.75 Carbon	4.30¢			4.30¢			(Worcester = 4.50¢)								
0.76 to 1.00 Carbon	6.15¢			6.15¢			(Worcester = 6.35¢)								
1.01 to 1.25 Carbon	8.35¢			8.35¢			(Worcester = 8.55¢)								
Bright Wire[14]	2.60¢	2.60¢		2.60¢	2.60¢		(Worcester = 2.70¢)			(Duluth = 2.65¢)		3.10¢			2.92¢
Galvanized Wire	Add proper size extra and galvanizing extra to Bright Wire base.														
Spring (High Carbon)	3.20¢	3.20¢		3.20¢			(Worcester = 3.30¢)					3.70¢			3.52¢
Steel Sheet Piling	2.40¢	2.40¢				2.40¢						2.95¢			2.72¢

EXCEPTIONS TO PRICE SCHED. NO. 6

Slabs—Andrews Steel Co. $41 basing pts.; Wheeling Steel Corp. (rerolling) 4 in. sq. or larger $37.75 f.o.b. Portsmouth, Ohio; Empire Sheet & Tin Plate Corp. $41; Phoenix Iron Co. (rerolling) $41, (forging) $47; Granite City Steel $47.50. **Blooms**—Phoenix Iron Co. (rerolling) $41, (forging) $47; Pgh. Steel Co. (reroll) $38.25, (forging) $44.25. Wheeling Steel Corp. (rerolling) 4 in. sq. or larger $37.75 f.o.b. Portsmouth.

Sheet bar—Empire Sheet & Tin Plate Co. $39 mill; Wheeling Steel Corp. $38 Portsmouth, Ohio.

Billets, Forging—Andrews Steel Co. $50 basing pts.; Follansbee Steel Corp. $49.50 Toronto; Phoenix Iron Co. $47.00 mill. Geneva Steel Co. $64.64 f.o.b. Pacific Coast; Pittsburgh Steel Co. $49.50.

Billets, Rerolling—Continental Steel Corp. may charge Acme Steel in Chicago switching area $34 plus freight from Kokomo, Ind.; Northwestern Steel & Wire Co. (Lend-Lease) $41 mill; Wheeling Steel Corp. 4 in. sq. or larger $37.75, smaller $39.50 f.o.b. Portsmouth, Ohio; Stanley Works may sell Washburn Wire Co. under allocation at $39 Bridgeport, Conn.; Keystone Steel & Wire Co. may sell Acme Steel Co. at Chicago base, f.o.b. Peoria; Phoenix Iron Co. $41 mill; Continental Steel Corp. (1¾ x 1¾) $39.50, (2 x 2 $40.60 Kokomo, Ind. (thse prices include $1 size extra); Keystone Steel & Wire Co. $36.40 Peoria; Connors Steel Co. $50.60 Birmingham; Ford Motor Co. $34 Dearborn, Mich. Geneva Steel Co. $58.64 f.o.b. Pac. C. Pgt. Steel Co. $43.50.

Structural Shapes—Phoenix Iron Co. $2.35 basing pts. (export) $2.50 Phoenixville; Knoxville Iron Co. $2.30 basing points.

Rails—Sweet Steel Co. (rail steel) $50 mill; West Virginia Rail Co. (lightweight) on allocation based Huntington, W. Va.; Colorado Fuel & Iron Corp., $45 Pueblo.

Hot Rolled Plate—Granite City Steel Co. $2.65 mill; Knoxville Iron Co. $2.25 basing pts.; Kaiser Co. and Geneva Steel Co. $3.20 Pacific Ports; Central Iron and Steel Co. $2.50 basing points; Granite City Steel Co. $2.35 Granite City.

Merchant Bars—W. Ames Co., 10 tons and over, $2.85 mill; Eckels-Nye Steel Corp., $2.50 basing pts. (rail steel) $2.40; Phoenix Iron Co. $2.40 basing pts.; Sweet Steel Co. (rail steel) $2.35 mill; Joslyn Mfg . &Supply Co., $2.35 Chicago; Calumet Steel Div., Borg Warner Corp. (8 in. mill bar) $2.35 Chicago; Knoxville Iron Co. $2.30 basing pts. Laclede Steel Co., sales to LaSalle Steel granted Chicago base, f.o.b. Madison, Ill. Milton Mfg. Co. $2.75 f.o.b. Milton, Pa.

Pipe Skelp—Wheeling Steel Corp., Benwood, $2.05 per cwt.

Reinforcing Bars—W. Ames & Co., 10 tons and over, $2.85 mill; Sweet Steel Co. (rail steel) $2.35 mill; Columbia Steel Co. $2.50 Pacific Ports.

Cold Finished Bars—Keystone Drawn Steel Co. on allocation, Pittsburgh c.f. base plus c/l freight on hot rolled bars Pittsburgh to Spring City, Pa.; New England Drawn Steel Co. on allocation outside New England, Buffalo c.f. base plus c/l freight Buffalo to Mansfield, Mass., f.o.b. Mansfield; Empire Finished Steel Corp. on allocation outside New England, Buffalo c.f. base plus c/l freight Buffalo to plants f.o.b. plant; Compressed Steel Shafting Co. on allocation outside New England, Buffalo base plus c/l freight Buffalo to Readville, Mass. f.o.b. Readville; Medart Co. in certain areas, Chicago c.f. base plus c/l freight Chicago to St. Louis, f.o.b. St. Louis.

Alloy Bars—Texas Steel Co. for delivery except Texas and Okla. Chicago, base, f.o.b. Fort Worth, Tex.; Conors Steel Co. shipped outside Ala., Mississippi, Louisiana, Georgia, Florida, Tenn., Pittsburgh base, f.o.b. Birmingham.

Hot Rolled Strip—Joslyn Mfg. & Supply Co. $2.30 Chicago; Knoxville Iron Co. $2.25 basing pts.

Hot Rolled Sheets—Andrews Steel Co., Middletown base on shipments to Detroit or area; Parkersburg Iron & Steel Co., $2.25 Parkersburg.

Galvanized Sheets—Andrews Steel Co. $3.75 basing pts.; Parkersburg Iron & Steel Co. $3.85 Parkersburg; Continental Steel Co., Middletown base on Kokomo, Ind., product; Superior Sheet Steel Co., Pittsburgh base except for Lend-Lease.

Pipe and Tubing—South Chester Tube Co. when priced at Pittsburgh, freight to Gulf Coast and Pacific Ports may be charged from Chester, Pa., also to points lying west of Harrisburg, Pa.

Black Sheets—Empire Sheet and Tinplate Co., maximum base price mill is $2.45 per 100 lb., with differentials, transportation charges, etc., provided in RPS. No. 6.

WAREHOUSE PRICES

Delivered metropolitan areas per 100 lb. These are zoned warehouse prices in conformance with latest zoning amendment to OPA Price Schedule 49.

Cities	SHEETS			STRIP		Plates ¼ in. and heavier	Structural Shapes	BARS		ALLOY BARS			
	Hot Rolled (10 gage)	Cold Rolled	Galvanized (24 gage)	Hot Rolled	Cold Rolled			Hot Rolled	Cold Finished	Hot Rolled, NE 8617-20	Hot Rolled, NE 9442-45 Ann.	Cold Drawn, NE 8617-20	Cold Drawn, NE 9442-45 Ann.
**Philadelphia	3.518	4.872[6]	5.018[a]	3.922	4.772	3.605	3.666	3.822	4.072	5.968	7.068	7.272	8.322
New York	3.590	4.813[3]	5.010	3.974[6]	4.772	3.768	3.758	3.853	4.103	6.008	7.108	7.303	8.353
Boston	3.744	4.744[9]	5.224[9]	4.106	4.715	3.912	3.912	4.044	4.144	6.162	7.262	7.344	8.394
Baltimore	3.394	4.852	4.894	3.902	4.752	3.594	3.759	3.802	4.052	....	....	....	....
Norfolk	3.771	4.965	5.371	4.165	4.865	3.971	4.002	4.065	4.165	....	....	....	....
Chicago	3.25	4.20	5.231	3.60	4.65[17]	3.55	3.55	3.50	3.75	5.75	6.85	6.85	7.90
Milwaukee	3.387	4.337[3]	5.272[4]	3.737	4.787[17]	3.687	3.687	3.637	3.887	5.987	7.087	7.087	8.137
Cleveland	3.35	4.40	4.877[4]	3.60	4.45	3.40	3.588	3.35	3.75	5.956	7.056	6.85	7.90
Buffalo	3.35	4.40	4.75[4]	3.819	4.669	3.63	3.40	3.35	3.75	5.75	6.85	6.85	7.90
Detroit	3.45	4.50	5.00[4]	3.70	4.659[17]	3.609	3.661	3.45	3.80	6.08	7.18	7.159	8.209
Cincinnati	3.425	4.475[3]	4.825[5]	3.675	4.711	3.611	3.691	3.611	4.011	....	....	....	....
St. Louis	3.397	4.347[3]	5.172[4]	3.747	4.931[17]	3.697	3.697	3.647	4.031	6.131	7.231	7.231	8.281
Pittsburgh	3.35	4.40	4.75	3.60	4.45	3.40	3.40	3.35	3.75	5.75	6.85	6.85	7.90
St. Paul	3.51	4.48	5.257[4]	3.86	4.35[17]	3.813[3]	3.813[3]	3.763[3]	4.361	6.09	7.19	7.561	8.711
Omaha	3.865	5.443	5.608[4]	4.215	....	4.165	4.165	4.115	4.43	....	....	....	....
Indianapolis	3.58	3.58	4.568	4.918	3.768	4.78	3.63	3.58	3.98	6.08	7.18	7.18	8.23
Birmingham	3.45	....	4.75	3.70	....	3.55	3.55	3.50	4.43	....	....	....	....
Memphis	3.965[7]	4.66	3.285	4.215	....	4.065	4.065	4.015	4.33	....	....	....	....
New Orleans	4.058[9]	4.95	5.358	4.308	....	4.158	4.158[9]	4.108[9]	4.629	....	....	....	....
Houston	3.763	5.573	6.313[1]	4.313	....	4.25	4.25	3.75	6.373[2]	7.223	8.323	8.323	9.373
Los Angeles	5.00	7.20[3]	6.10[4]	4.95	5.813[15]	4.95	4.65	4.40	5.583	8.304	9.404	9.404	10.454
San Francisco	4.55[14]	7.30[4]	6.35[4]	4.50[14]	7.333[17]	4.65[14]	4.35[14]	4.15[14]	5.333	8.304	9.404	9.404	10.454
Seattle	4.65[12]	7.05[4]	5.95[4]	4.25[12]	....	4.75[12]	4.45[12]	4.35[12]	5.783	....	9.404	....	....
Portland	4.65[11]	6.60[4]	5.75[4]	4.75[11]	....	4.75[11]	4.45[11]	4.45[11]	5.533	8.304	9.404	8.304	9.404
Salt Lake City	4.53[17]	....	6.17[18]	5.53[17]	....	4.98[17]	4.98[17]	4.88[17]	5.90	....	....	....	....

MILL EXTRAS FOR NATIONAL EMERGENCY STEELS

Designation	Basic Open-Hearth		Electric Furnace		Designation	Basic Open-Hearth		Electric Furnace	
	Bars and Bar-Strip	Billets, Blooms, and Slabs	Bars and Bar-Strip	Billets, Blooms, and Slabs		Bars and Bar-Strip	Billets, Blooms, and Slabs	Bars and Bar-Strip	Billets, Blooms, and Slabs
NE 1330	0.10¢	$2.00	....	.....	NE 9415	0.75¢	$15.00	$1.25	$25.00
NE 1335	0.10	2.00	....	.....	NE 9417	0.75	15.00	1.25	25.00
NE 1340	0.10	2.00	....	.....	NE 9420	0.75	15.00	1.25	25.00
NE 1345	0.10	2.00	....	.....	NE 9422	0.75	15.00	1.25	25.00
NE 1350	0.10	2.00	....	.....	NE 9425	0.75	15.00	1.25	25.00
					NE 9427	0.75	15.00	1.25	25.00
					NE 9430	0.75	15.00	1.25	25.00
NE 8612	0.65¢	$13.00	$1.15	$23.00	NE 9432	0.75	15.00	1.25	25.00
NE 8615	0.65	13.00	1.15	23.00	NE 9435	0.75	15.00	1.25	25.00
NE 8617	0.65	13.00	1.15	23.00	NE 9437	0.75	15.00	1.25	25.00
NE 8620	0.65	13.00	1.15	23.00	NE 9440	0.75	15.00	1.25	25.00
NE 8622	0.65	13.00	1.15	23.00	NE 9442	0.80	16.00	1.30	26.00
NE 8625	0.65	13.00	1.15	23.00	NE 9445	0.80	16.00	1.30	26.00
NE 8627	0.65	13.00	1.15	23.00	NE 9447	0.80	16.00	1.30	26.00
NE 8630	0.65	13.00	1.15	23.00	NE 9450	0.80	16.00	1.30	26.00
NE 8632	0.65	13.00	1.15	23.00					
NE 8635	0.65	13.00	1.15	23.00					
NE 8637	0.65	13.00	1.15	23.00	NE 9722	0.65¢	$13.00	$1.15	$23.00
NE 8640	0.65	13.00	1.15	23.00	NE 9727	0.65	13.00	1.15	23.00
NE 8642	0.65	13.00	1.15	23.00	NE 9732	0.65	13.00	1.15	23.00
NE 8645	0.65	13.00	1.15	23.00	NE 9737	0.65	13.00	1.15	23.00
NE 8647	0.65	13.00	1.15	23.00	NE 9742	0.65	13.00	1.15	23.00
NE 8650	0.65	13.00	1.15	23.00	NE 9745	0.65	13.00	1.15	23.00
					NE 9747	0.65	13.00	1.15	23.00
					NE 9750	0.65	13.00	1.15	23.00
NE 8712	0.70¢	$14.00	$1.20	$24.00	NE 9763	0.65	13.00	1.15	23.00
NE 8715	0.70	14.00	1.20	24.00	NE 9768	0.65	13.00	1.15	23.00
NE 8717	0.70	14.00	1.20	24.00					
NE 8720	0.70	14.00	1.20	24.00					
NE 8722	0.70	14.00	1.20	24.00	NE 9830	$1.30	$26.00	$1.80	$36.00
NE 8725	0.70	14.00	1.20	24.00	NE 9832	1.30	26.00	1.80	36.00
NE 8727	0.70	14.00	1.20	24.00	NE 9935	1.30	26.00	1.80	36.00
NE 8730	0.70	14.00	1.20	24.00	NE 9837	1.30	26.00	1.80	36.00
NE 8732	0.70	14.00	1.20	24.00	NE 9840	1.30	26.00	1.80	36.00
NE 8735	0.70	14.00	1.20	24.00	NE 9842	1.30	26.00	1.80	36.00
NE 8737	0.70	14.00	1.20	24.00	NE 9845	1.30	26.00	1.80	36.00
NE 8740	0.70	14.00	1.20	24.00	NE 9847	1.30	26.00	1.80	36.00
NE 8742	0.70	14.00	1.20	24.00	NE 9850	1.30	26.00	1.80	36.00
NE 8745	0.70	14.00	1.20	24.00					
NE 8747	0.70	14.00	1.20	24.00					
NE 8750	0.70	14.00	1.20	24.00	NE 9912	$1.20	$24.00	$1.55	$31.00
					NE 9915	1.20	24.00	1.55	31.00
					NE 9917	1.20	24.00	1.55	31.00
NE 9255	0.40¢	$8.00	....	.....	NE 9920	1.20	24.00	1.55	31.00
NE 9260	0.40	8.00	....	.....	NE 9922	1.20	24.00	1.55	31.00
NE 9261	0.65	13.00	....	.....	NE 9925	1.20	24.00	1.55	31.00
NE 9262	0.65	13.00	....	.....					
					NE 52100A	....	.....	$2.60	$52.00
					NE 52100B	....	.....	2.60	52.00
					NE 52100C	....	.....	2.60	52.00

Note 1: The ranges shown are restricted to sizes 100 sq. in. or less or equivalent cross-sectional area 18 in. wide or under, with a maximum individual piece weight of 7000 lb. irrespective of size. **Note 2:** For steels ordered to such ranges, below the size and weight restriction, the average of all the chemical checks must be within the limits specified subject to check analysis variations given in Table 4, Section 10, A.I.S.I. Steel Products Manual. **Note 3:** When acid open-hearth is specified and acceptable, add to basic open-hearth alloy differential 0.25c. per lb. for bars and bar strip and $5 per gross ton for billets, blooms and slabs. **Note 4:** The extras shown are in addition to the base price of $2.70 for 100 lb. on finished products and $54 per gross ton on semi-finished steel, major basing points, and are in cents per pound when applicable to bars and bar-strip, and in dollars per gross ton when applicable to billets, blooms and slabs. The full extra applicable over the base price is the total of all extras indicated by the specific requirements of the order. The higher extra shall be charged for any size falling between two published extras.

BASE QUANTITIES

Standard unless otherwise keyed on prices.

HOT ROLLED: Sheets, strip, plates, shapes and bars, 400 to 1999 lb.

COLD ROLLED: Sheets, 400 to 1499 lb.; strip, extras on all quantities; bars, 1500 lb. base; NE alloy bars, 1000 to 39,999 lb.

EXCEPTIONS: (1) 150 to 499 lb. (2) 150 to 1499 lb. (3) 400 to 1499 lb. (4) 450 to 1499 lb. (5) 500 to 1499 lb. (6) 0 to 1999 lb. (7) 400 to 1999 lb. (8) 1000 to 1999 lb. (9) 450 to 3749 lb. (10) 400 to 3999 lb. (11) 300 to 4999 lb. (12) 300 to 10,000 lb. (13) 400 to 14,999 lb. (14) 400 lb. and over. (15) 1000 lb. and over. (16) 1500 lb. and over. (17) 2000 lb. and over. (18) 3500 lb. and over.

(a) Philadelphia: Galvanized sheet, 25 or more bundles.

Extra for size, quality, etc., apply on above quotations.

*Add 0.27¢. for sizes not rolled in Birmingham.

**City of Philadelphia only. Applicable freight rates must be added to basing point prices to obtain delivered price to other localities in metropolitan area.

LAKE SUPERIOR ORES

(51.50% *Fe, Natural Content, Delivered Lower Lake Ports**)

	Per Gross Ton
Old range, bessemer, 51.50	$4.75
Old range, non-bessemer, 51.50	4.60
Mesaba, bessemer, 51.50	4.60
Mesaba, non-bessemer, 51.50	4.45
High phosphorus, 51.50	4.35

*Adjustments are made to indicate prices based on variance of Fe content of ores as analyzed on a dry basis by independent laboratories.

FLUORSPAR

Maximum price f.o.b. consumer's plant, $30 per short ton plus either (1) rail freight from producer to consumer, or (2) rail freight from Rosiclare, Ill., to consumer, whichever is lower.

Exception

When the WPB Steel Division certifies in writing the consumer's need for one of the higher grades of metallurgical fluorspar specified in the table below the price shall be taken from the table plus items (1 and 2) from paragraph above.

Effective CaF_2 Content:	*Base price per short ton*
70% or more	$33.00
65% but less than 70%	32.00
60% but less than 65%	31.00
Less than 60%	30.00

PRICES

SEMI-FINISHED STEEL

Ingots, Carbon, Rerolling

Base per gross ton, f.o.b. mill.... $31.00

Exceptions: Phoenix Iron Co. may charge $38.75; Kaiser Co., $43.00 f.o.b. Pacific Coast ports; Empire Sheet & Tinplate Co., $34.25; Pgh. Steel Co., $33.10.

Ingots, Carbon, Forging

Base per gross ton, f.o.b. Birmingham, Buffalo, Chicago, Cleveland, Gary, Pittsburgh, Youngstown $36.00

Exceptions: Phoenix Iron Co. may charge $43.00; Empire Sheet & Tinplate Co., $39.25, f.o.b. Mansfield, Ohio; West Coast producers, $48.00, f.o.b. Pacific Coast Ports; Pgh. Steel Co., $38.10.

Ingots, Alloy

Base per gross ton, f.o.b. Bethlehem, Buffalo, Canton, Coatesville, Chicago, Massillon, Pittsburgh $45.00

Exceptions: C/L delivered Detroit add $2.00; delivered East Michigan add $3.00. Connors Steel Co. may charge $45.00 f.o.b. Birmingham.

Billets, Blooms and Slabs

Pittsburgh, Chicago, Gary, Cleveland, Youngstown, Buffalo, Birmingham, Sparrows Point (rerolling only). Prices delivered Detroit are $2.00 higher; delivered E. Michigan, $3 higher; f.o.b. Duluth, billets only, $2.00 higher; billets f.o.b. Pacific ports are $12 higher. Provo, $11.20 higher. Delivered prices do not reflect three per cent tax on freight rates.

	Per Gross Ton
Rerolling	$34.00
Forging quality	40.00

For exceptions on semi-finished steel see the footnote on the page of finished steel prices.

Alloy Billets, Blooms, slabs

Pittsburgh, Chicago, Canton, Massillon, Buffalo, or Bethlehem, per gross ton $54.00

Price delivered Detroit $2.00 higher: E. Michigan, $3.00 higher.

Shell Steel

	Per Gross Ton
3 in. to 12 in.	$52.00
12 in. to 18 in.	54.00
18 in. and over	56.00

Basic open hearth shell steel, f.o.b. Pittsburgh, Chicago, Buffalo, Gary, Cleveland, Youngstown and Birmingham.

Prices delivered Detroit are $2.00 higher; E. Michigan, $3 higher.

Price Exception: Follansbee Steel Corp. permitted to sell at $13.00 per gross ton, f.o.b. Toronto, Ohio, above base price of $52.00.

Note: The above base prices apply on lots of 1000 tons of a size and section to which are to be added extras for chemical requirements, cutting, or quantity.

Sheet Bars

Pittsburgh, Chicago, Cleveland, Youngstown, Buffalo, Canton, Sparrows Point.

	Per Gross Ton
Open hearth or bessemer	$34.00

Skelp

Pittsburgh, Chicago, Youngstown, Coatesville, Pa., Sparrows Point, Md.

	Per Lb.
Grooved, universal and sheared	1.90c.

Wire Rods

(*No. 5 to 9/32 in.*)

	Per Lb.
Pittsburgh, Chicago, Cleveland	2.00c.
Worcester, Mass.	2.10c.
Birmingham	2.00c.
San Francisco	2.50c.
Galveston	2.25c.

9/32 in. to 47/64 in., 0.15c. a lb. higher. Quantity extras apply.

TOOL STEEL

(*F.o.b. Pittsburgh, Bethlehem, Syracuse*)

	Base per lb.
High speed	67c.
Straight molybdenum	54c.
Tungsten-molybdenum	57½c.
High-carbon-chromium	43c.
Oil hardening	24c.
Special carbon	22c.
Extra carbon	18c.
Regular carbon	14c.

Warehouse prices east of Mississippi are 2c. a lb. higher; west of Mississippi 3c. higher.

Trained operator of
Clark
Fork Trucks
moving heavy casting in the plant of the Union Steam Pump Co. in Battle Creek, Michigan.
Trained operators reduce handling cost—increase production—save time.
CLARK TRUCTRACTOR
BATTLE CREEK, MICHIGAN, U.S.A.
"Unskilled labor adds nothing to a product except cost."
Ezra W. Clark

Whatever your requirements in
CAP SCREWS
CLEVELAND
makes them of greater strength and accuracy by the Kaufman Process.
CLEVELAND Top Quality FASTENERS
The Cleveland Cap Screw Company
2929 EAST 79TH STREET • CLEVELAND 4, OHIO
Warehouses: Chicago, Philadelphia, New York, Los Angeles
MADE BY THE ORIGINATORS OF THE KAUFMAN PROCESS FOR GREATER STRENGTH AND ACCURACY

C-F POSITIONERS

When "Position" Counts Most

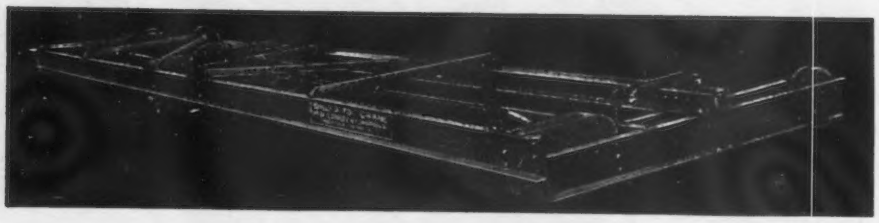
On automatic welding jobs, like the one illustrated here, position counts "most," and with the C-F Positioner (with 6 sizes, and capacities to 30,000 lbs.) the tables tilt to 135° beyond horizontal and rotate 360°, all under push button control. The exclusive C-F Variable-Speed Control gives table rotations ranging from 0 R.P.M. up for all sizes. For "quick change" of position, for greater time saving and efficiency, for lower costs and greater safety to men and materials, specify C-F Positioners for all *automatic* and production welding operations.

Write for Bulletin WP-22

CULLEN-FRIESTEDT CO.

1303 S. Kilbourn Ave. Chicago 23, Ill.

CONCO 3-Motor Single Girder CAB OR FLOOR OPERATED ELECTRIC CRANE . . .



● **Available in capacities of one through five tons for floor or cab operation. Simply, ruggedly designed for low first cost and maintenance. Used with Low Headroom Type Hoist, provides for maximum space coverage horizontally and vertically. Effective in even a minimum space. Write for Bulletin 2000.**

Write for Bulletin 26000 describing the Torpedo Hoist shown. Three capacities 250 lb. — $139.50, 500 lb. — $149.50, 1000 lb. — $159.50. Heavily, simply built, with Push Button Control. Outstanding in CONCO'S complete line of hand-powered and electric Cranes, Hoists, Trolleys.

CONCO ENGINEERING WORKS

Div. of H. D. Conkey & Co. — 15 Grove St. — Mendota, Ill.

Builders Of Conco Torpedo Electric Hoist

PRICES

WELDED PIPE AND TUBING

Base Discounts, f.o.b. Pittsburgh District and Lorain, Ohio, Mills

(F.o.b. Pittsburgh only on wrought pipe)
Base Price—$200.00 per Net Ton

	Black	Galv.
Steel (Butt Weld)		
½ in.	63½	51
¾ in.	66½	55
1 to 3 in.	68½	57½
Wrought Iron (Butt Weld)		
½ in.	24	3½
¾ in.	30	10
1 and 1¼ in.	34	16
1½ in.	38	18½
2 in.	37½	18
Steel (Lap Weld)		
2 in.	61	49½
2½ and 3 in.	64	52½
3½ to 6 in.	66	54½
Wrought Iron (Lap Weld)		
2 in.	30½	13
2½ to 3½ in.	31½	14½
4 in.	33½	18
4½ to 8 in.	32½	17
Steel (Butt, extra strong, plain ends)		
½ in.	61½	50½
¾ in.	65½	54½
1 to 3 in.	67	57
Wrought Iron (Same as Above)		
½ in.	25	6
¾ in.	31	13
1 to 2 in.	38	19½
Steel (Lap, extra strong, plain ends)		
2 in.	59	48½
2½ and 3 in.	63	52½
3½ to 6 in.	66½	56
Wrought Iron (Same as Above)		
2 in.	33½	15½
2½ to 4 in.	39	23½
4½ to 6 in.	37½	21

On butt weld and lap weld steel pipe jobbers are granted a discount of 5%. On less-than-carload shipments prices are determined by adding 25 and 30% and the carload freight rate to the base card.

F.o.b. Gary prices are two points lower discount or $4 a ton higher than Pittsburgh or Lorain on lap weld and one point lower discount, or $2 a ton higher on all butt weld.

CAST IRON WATER PIPE

	Per Net Ton
6-in. and larger, del'd Chicago	$54.80
6-in. and larger, del'd New York	52.30
6-in. and larger, Birmingham	46.00
6-in. and larger f.o.b. cars, San Francisco or Los Angeles	69.40
6-in. and larger f.o.b. cars, Seattle	71.20

Class "A" and gas pipe, $3 extra; 4-in. pipe is $3 a ton above 6-in. Prices shown are for lots of less than 200 tons. For 200 tons or over, 6-in. and larger are $45 at Birmingham and $53.80 delivered Chicago, $59.40 at San Francisco and Los Angeles, and $70.20 at Seattle. Delivered prices do not reflect new 3 per cent tax on freight rates.

BOILER TUBES

Seamless Steel and Lap Weld Commercial Boiler Tubes and Locomotive Tubes, Minimum Wall. Net base prices per 100 ft. f.o.b. Pittsburgh, in carload lots.

	Seamless Cold Drawn	Seamless Hot Rolled	Lap Weld, Hot Rolled
2 in. o.d. 13 B.W.G.	15.03	13.04	12.38
2½ in. o.d. 12 B.W.G.	20.21	17.54	16.58
3 in. o.d. 12 B.W.G.	22.48	19.50	18.35
3½ in. o.d. 11 B.W.G.	28.37	24.62	23.15
4 in. o.d. 10 B.W.G.	35.20	30.54	28.66

(Extras for less carload quantities)

40,000 lb. or ft., and over	Base
30,000 lb. or ft. to 39,999 lb. or ft.	5%
20,000 lb. or ft. to 29,999 lb. or ft.	10%
10,000 lb. or ft. to 19,999 lb. or ft.	20%
5,000 lb. or ft. to 9,999 lb. or ft.	30%
2,000 lb. or ft. to 4,999 lb. or ft.	45%
Under 2,000 lb. or ft.	65%

PRICES

WIRE PRODUCTS

To the trade, f.o.b. Pittsburgh, Chicago, Cleveland, Birmingham, Duluth

	Basing Points Named	Pacific Coast Basing Points†
	Base per Keg	
Standard wire nails	$2.55	$3.05
Coated nails	2.55	3.05
Cut nails, carloads	3.85	....
	Base per 100 lb.	
Annealed fence wire	$3.05	$3.55
Annealed galv. fence wire	3.40	3.90
	Base Column	
Woven wire fence*	.67	.85
Fence posts, carloads	.69	.86
Single loop bale ties	.59	.84
Galvanized barbed wire**	.70	.80
Twisted barbless wire	.70	....

*15½ gage and heavier. **On 80-rod spools in carload quantities.

†Prices subject to switching or transportation charges.

BOLTS, NUTS, RIVETS, SET SCREWS

Bolts and Nuts

(F.o.b. Pittsburgh, Cleveland, Birmingham or Chicago)

Machine and Carriage Bolts:

Base discount less case lots

	Per Cent Off List
½ in. & smaller x 6 in. & shorter	65½
3/16 & ⅝ in. x 6 in. & shorter	63½
¾ to 1 in. x 6 in. shorter	61
1⅛ in. and larger, all lengths	59
All diameters over 6 in. long	59
Lag, all sizes	62
Plow bolts	65

Nuts, Cold Punched or Hot Pressed:

(Hexagon or Square)

½ in. and smaller	62
9/16 to 1 in. inclusive	59
1⅛ to 1½ in. inclusive	57
1⅝ in. and larger	56

On above bolts and nuts, excepting plow bolts, additional allowance of 10 per cent for full container quantities. There is an additional 5 per cent allowance for carload shipments.

Semi-Fin. Hexagon Nuts	U.S.S.	S.A.E.
Base discount less keg lots		
7/16 in. and smaller	..	64
½ in. and smaller	62	..
½ in. through 1 in.	..	60
9/16 in. through 1 in.	59	..
1⅛ in. through 1½ in.	57	58
1⅝ in. and larger	56	..

In full keg lots, 10 per cent additional discount.

Stove Bolts	*Consumer*
Packages, nuts loose	71 and 10
In packages, with nuts attached	71
In bulk	80

On stove bolts freight allowed up to 35c. per 100 lb. based on Cleveland, Chicago, New York on lots of 200 lb. or over.

Large Rivets

(½ in. and larger)

	Base per 100 Lb.
F.o.b. Pittsburgh, Cleveland, Chicago, Birmingham	$3.75

Small Rivets

(7/16 in. and smaller)

	Per Cent Off List
F.o.b. Pittsburgh, Cleveland, Chicago, Birmingham	65 and 5

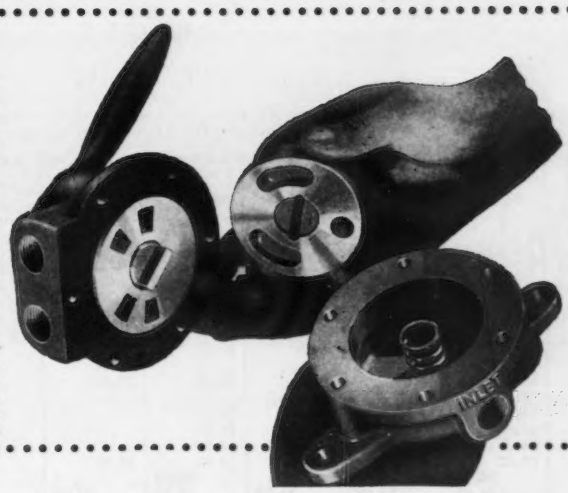
Cap and Set Screws	*Consumer Per Cent Off List*
Upset full fin. hexagon head cap screws, coarse or fine thread, up to and incl. 1 in. x 6 in.	64
Upset set screws, cup and oval points	71
Milled studs	46
Flat head cap screws, listed sizes	36
Fillister head cap, listed sizes	51

Freight allowed up to 65c. per 100 lb. based on Cleveland, Chicago or New York on lots of 200 lb. or over.

ROOFING TERNE PLATE

(F.o.b. Pittsburgh, 112 Sheets)

	20x14 in.	20x28 in.
8-lb. coating I.C.	$6.00	$12.00
15-lb. coating I.C.	7.00	14.00
30-lb. coating I.C.	7.50	15.00



MAKE THE MOST OF AIR POWER

Hannifin "Packless" Air Control Valves provide the smooth acting, positive control of air operated equipment that means better performance and maximum use of air power. Disc-type design, with the bronze disc ground and lapped to make a perfect seal with the seat, does away with packing, provides lasting leak-proof operation and smooth acting control.

Hannifin Air Control Valves are made in 3-way and 4-way types, hand and foot operated, manifold, spring return, and heavy duty rotary types. Write for cylinder and valve bulletin with complete data. Hannifin Manufacturing Company, 621-631 South Kolmar Ave., Chicago 24, Illinois.

Hannifin

AIR CONTROL VALVES

ETNA

A client of ours had a job of pointing heavy-walled copper tubing, and wanted to speed up the operation. Just how to do it didn't appear on the horizon, and so they did the safe and logical thing—they put their swaging job up to Etna.

The answer to that problem is illustrated on this page. It's a modern Etna Swaging Machine that points *more* copper tubes per hour in less time at less cost. If you have a problem involving tapering or reducing tubing and solid rounds—ask Etna about it.

Etna has the swaging machines from ⅜" to 4" and the experience to help you get the most out of this type of machine.

IF IT'S A QUESTION OF TAPERING, SIZING OR REDUCING OF ROUND SOLIDS OR TUBING... "Ask ETNA About Swaging"

ETNA MACHINE COMPANY TOLEDO OHIO

PIG IRON

All prices set in bold face type are maximum established by OPA on June 24, 1941. Other domestic prices (in italics) are delivered quotations per gross ton computed on the basis of the official maximum. Delivered prices do not reflect 3 per cent tax on freight rates.

	No. 2 Foundry	Basic	Bessemer	Malleable	Low Phosphorus	Charcoal
Boston	*$25.50*	*$25.00*	*$26.50*	*$26.00*	.....	.....
Brooklyn	*27.50*	*27.00*	.....	*28.00*	.....	.....
Jersey City	*26.53*	*26.03*	*27.53*	*27.03*	.....	.....
Philadelphia (4)	*25.84*	*25.34*	*26.84*	*26.34*	*$30.74*	.....
Bethlehem, Pa.	$25.00	$24.50	$26.00	$25.50	.....	.....
Everett, Mass.	25.00	24.50	26.00	25.50	.....	.....
Swedeland, Pa.	25.00	24.50	26.00	25.50	.....	.....
Steelton, Pa.	.....	24.50	.....	.....	$29.50	.....
Birdsboro, Pa. (3)	25.00	24.50	26.00	25.50	29.50	.....
Sparrows Point, Md.	25.00	24.50	.....	.....	.....	.....
Erie, Pa.	24.00	23.50	25.00	24.50	.....	.....
Neville Island, Pa.	24.00	23.50	24.50	24.00	.....	.....
Sharpsville, Pa. (1)	24.00	23.50	24.50	24.00	.....	.....
Buffalo	24.00	23.00	25.00	24.50	29.50	.....
Cincinnati, Ohio	*25.11*	*24.61*	.....	*25.11*	.....	.....
Canton, Ohio	*25.39*	*24.89*	*25.89*	*25.39*	*32.69*	.....
Mansfield, Ohio	*25.94*	*25.44*	*26.44*	*25.94*	*32.86*	.....
St. Louis	*24.50*	*24.50*	.....	.....	.....	.....
Chicago	24.00	23.50	24.50	24.00	*35.46*	*$37.34*
Granite City, Ill.	24.00	23.50	24.50	24.00	.....	.....
Cleveland	24.00	23.50	24.50	24.00	*32.42*	.....
Hamilton, Ohio	24.00	23.50	.....	24.00	.....	.....
Toledo	24.00	23.50	24.50	24.00	.....	.....
Youngstown	24.00	23.50	24.50	24.00	*32.42*	.....
Detroit	24.00	23.50	24.50	24.00	.....	.....
Lake Superior fc.	.....	.....	.....	.....	.....	34.00
Lyles, Tenn., fc. (2)	.....	.....	.....	.....	.....	33.00
St. Paul	*26.63*	26.13	*27.1*	*26.63*	*39.80*	.....
Duluth	24.50	24.00	25.00	24.50	.....	.....
Birmingham	20.38	19.00	25.00	.....	.....	.....
Los Angeles	*26.95*	.....	.....	.....	.....	.....
San Francisco	*26.95*	.....	.....	.....	.....	.....
Seattle	*26.95*	.....	.....	.....	.....	.....
Provo, Utah	22.00	21.50	.....	.....	.....	.....
Montreal	*27.50*	*27.50*	.....	*28.00*	.....	.....
Toronto	*25.50*	*25.50*	.....	*26.00*	.....	.....

GRAY FORGE IRON: Valley or Pittsburgh furnace $23.50

(1) Pittsburgh Coke & Iron Co. (Sharpsville, Pa., furnace only) and the Struthers Iron & Steel Co., Struthers, Ohio, may charge 50c. a ton in excess of basing point prices for No. 2 foundry, basic, bessemer and malleable. Struthers Iron & Steel Co. may add another $1.00 per gross ton for iron from Struthers, Ohio, plant.

(2) Price shown is for low-phosphorus iron; high phosphorus sells for $28.50 at the furnace.

(3) E. & G. Brooke Co., Birdsboro, Pa., permitted to charge $1.00 per ton extra.

(4) Pittsburgh Ferromanganese Co. (Chester furnace only) may charge $2.25 a ton over maximum basing point prices.

Basing point prices are subject to switching charges; Silicon differentials (not to exceed 50c. a ton for each 0.25 per cent silicon content in excess of base grade which is 1.75 to 2.25 per cent); Phosphorus differentials, a reduction of 38c. per ton for phosphorus content of 0.70 per cent and over; Manganese differentials, a charge not to exceed 50c. per ton for each 0.50 per cent manganese content in excess of 1.00 per cent. Effective March 3, 1943, $2 per ton extra may be charged for 0.5 to 0.75 per cent nickel content and $1 per ton extra for each additional 0.25 per cent nickel.

METAL POWDERS

Prices are based on current market prices of ingots plus a fixed figure. F.o.b. shipping point, c. per lb., ton lots.

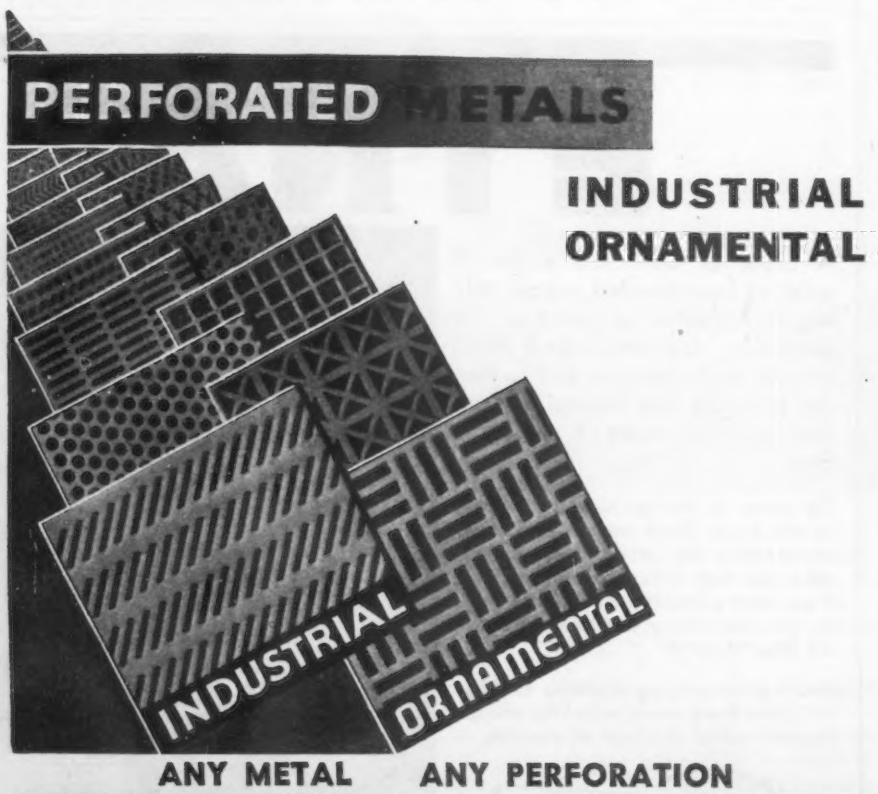
Copper, electrolytic, 150 and 200 mesh	21½ to 23½c.
Copper, reduced, 150 and 200 mesh	20½ to 25½c.
Iron, commercial, 100 and 200 mesh 96 + % Fe	13½ to 15c.
Iron, crushed, 200 mesh and finer, 90 + % Fe, carload lots	4c.
Iron, hydrogen reduced, 300 mesh and finer, 98½ + % Fe, drum lots	63c.
Iron, electrolytic, unannealed, 300 mesh and coarser, 99 + % Fe	30 to 33c.
Iron, electrolytic, annealed minus 100 mesh, 99 + % Fe	42c.
Iron, carbonyl, 300 mesh and finer, 98-99.8 + % Fe	90c.
Aluminum, 100 and 200 mesh	*23 to 27c.
Antimony, 100 mesh	20.6c.
Cadmium, 100 mesh	$1
Chromium, 150 mesh	$1.03
Lead, 100, 200 & 300 mesh, 11½ to 12½c.	
Manganese, 150 mesh	51c.
Nickel, 150 mesh	51½c.
Solder powder, 100 mesh, 8½c. plus metal	
Tin, 100 mesh	58¾c.
Tungsten metal powder, 98%-99%, any quantity, per lb.	$2.60
Molybdenum powder, 99%, in 200-lb. kegs, f.o.b. York, Pa., per lb.	$2.60
Under 100 lb.	$3.00

*Freight allowed east of Mississippi.

COKE

Furnace, beehive (f.o.b. oven)	Net Ton
Connellsville, Pa.	$7.00*
Foundry, beehive (f.o.b. oven)	
Fayette Co., W. Va.	8.10
Connellsville, Pa.	8.25
Foundry, By-Product	
Chicago, del'd	13.35
Chicago, f.o.b.	12.60
New England, del'd	14.25
Kearny, N. J., f.o.b.	12.65
Philadelphia, del'd	12.88
Buffalo, del'd	13.00
Portsmouth, Ohio, f.o.b.	11.10
Painesville, Ohio, f.o.b.	11.75
Erie, del'd	12.75
Cleveland, del'd	12.80
Cincinnati, del'd	12.85
St. Louis, del'd	13.85
Birmingham, del'd	10.50

*Hand drawn ovens using trucked coal permitted to charge $7.75 per ton plus transportation charges.



PRICES

REFRACTORIES
(F.o.b. Works)

Fire Clay Brick

	Per 1000
Super-duty brick, St. Louis	$64.60
First quality, Pa., Md., Ky., Mo., Ill.	51.30
First quality, New Jersey	56.00
Sec. quality, Pa., Md., Ky., Mo., Ill.	46.55
Sec. quality, New Jersey	51.00
No. 1 Ohio	43.00
Ground fire clay, net ton	7.60

Silica Brick

Pennsylvania and Birmingham	$51.30
Chicago District	58.90
Silica cement, net ton (Eastern)	9.00

Chrome Brick

	Per Net ton
Standard chemically bonded, Balt., Plymouth Meeting, Chester	$54.00

Magnesite Brick

Standard, Balt. and Chester	$76.00
Chemically bonded, Baltimore	65.00

Grain Magnesite

Domestic, f.o.b. Balt. and Chester in sacks (carloads)	$43.48
Domestic, f.o.b. Chewelah, Wash. (in bulk)	22.00

RAILS, TRACK SUPPLIES
(F.o.b. Mill)

Standard rails, heavier than 60 lb., No. 1 O.H., gross ton	$40.00
Angle splice bars, 100 lb.	2.70
(F.o.b. Basing Points)	*Per Gross Ton*
Light rails (from billets)	$40.00
Light rails (from rail steel)	39.00
	Base per Lb.
Cut spikes	3.00c.
Screw spikes	5.15c.
Tie plate, steel	2.15c.
Tie plates, Pacific Coast	2.30c.
Track bolts	4.75c.
Track bolts, heat treated, to railroads	5.00c.
Track bolts, jobbers discount	63-5

Basing points, light rails, Pittsburgh, Chicago, Birmingham; cut spikes and tie plates—Pittsburgh, Chicago, Portsmouth, Ohio, Weirton, W. Va., St. Louis, Kansas City, Minnequa, Colo., Birmingham and Pacific Coast ports; tie plates alone—Steelton, Pa., Buffalo. Cut spikes alone—Youngstown, Lebanon, Pa., Richmond, Oregon and Washington ports, add 25c.

CORROSION AND HEAT-RESISTING STEEL
(Per lb. base price, f.o.b. Pittsburgh)

Chromium-Nickel Alloys

	No. 304	No. 302
Forging billets	21.25c.	20.40c.
Bars	25.00c.	24.00c.
Plates	29.00c.	27.00c.
Structural shapes	25.00c.	24.00c.
Sheets	36.00c.	34.00c.
Hot rolled strip	23.50c.	21.50c.
Cold rolled strip	30.00c.	28.00c.
Drawn wire	25.00c.	24.00c.

Straight-Chromium Alloys

	No. 410	No. 430	No. 442	No. 446
F. Billets	15.725c.	16.15c.	19.125c.	23.375c.
Bars	18.50c.	19.00c.	22.50c.	27.50c.
Plates	21.50c.	22.00c.	25.50c.	30.50c.
Sheets	26.50c.	29.00c.	32.50c.	36.50c.
Hot strip	17.00c.	17.50c.	24.00c.	35.00c.
Cold strip	22.00c.	22.50c.	32.00c.	52.00c.

Chromium-Nickel Clad Steel (20%)

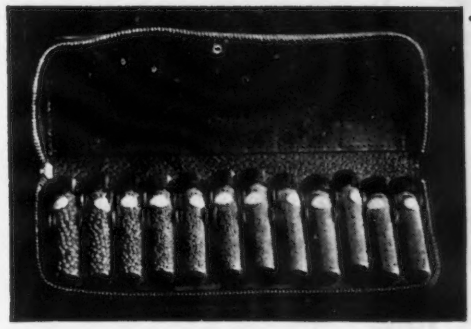
	No. 304
Plates	18.00c.*
Sheets	19.00c.

*Includes annealing and pickling.

ELECTRICAL SHEETS
(Base, f.o.b. Pittsburgh)

	Per Lb.
Field grade	3.20c.
Armature	3.55c.
Electrical	4.05c.
Motor	4.95c.
Dynamo	5.65c.
Transformer 72	6.15c.
Transformer 65	7.15c.
Transformer 58	7.65c.
Transformer 52	8.45c.

F.o.b. Granite City, add 10c. per 100 lb. on field grade to and including dynamo. Pacific ports add 75c. per 100 lb. on all grades.



HEAT-TREATED STEEL SHOT

We manufacture shot and grit for endurance

A shot or grit that will blast fast with a clean finish.

This is the only reason why so many operators are daily changing to our shot and grit, from Maine to California.

The unprecedented demand for our—

Heat-Treated Steel Shot and Heat-Treated Steel Grit

has enabled us to expand our production and maintain a quality that is more than satisfactory to our hundreds of customers all over the country.

HARRISON ABRASIVE CORPORATION

Manchester, New Hampshire

HEAT-TREATED STEEL GRIT

"HERCULES" REG. U.S. PAT. OFF. RED-STRAND WIRE ROPE

You Can Depend On "Hercules" (Red Strand) Wire Rope

Highlights of Quality

1. Acid Open-Hearth Steel Wire
2. Rigid Tests and Inspections
3. Correct Manufacturing Methods
4. Furnished in both the Round and Flattened Strand constructions, in either Standard or Preformed Type.

• • Results are what count, and the performance record of this wire rope continues to make and hold friends.

There is no guess work when you use "HERCULES" (Red-Strand) Wire Rope. It is designed and built to do specific jobs better . . . safer . . . more economically. If you will tell us how you use wire rope, we shall be glad to suggest the construction and type most suitable for your conditions.

MADE ONLY BY

A. LESCHEN & SONS ROPE CO.

WIRE ROPE MAKERS — ESTABLISHED 1857

5909 KENNERLY AVENUE — ST. LOUIS, MISSOURI, U. S. A.

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DENVER • • • 1554 Wazee Street

SAN FRANCISCO • • 320 Fourth Street
PORTLAND • • 914 N. W. 14th Avenue
SEATTLE • • 3410 First Avenue South

KING *Rings and Flanges*

Accurate, dependable, true-wearing. Standard styles or custom-made. KING likes the challenge of the unprecedented. How about it?

UNCLE BING SAYS:

"These long-range peace-planners remind me of the feller who wore his teeth to the gums anticipatin' a mince pie that burned-up in the oven. Let's do the job in sight now, namely—win the war."

KING FIFTH WHEEL COMPANY

2917 N. SECOND STREET, PHILADELPHIA 33, PA.

MACHINED BRONZE BEARINGS
GRAPHITED AND OILLESS BRONZE BEARINGS
BRONZE GEAR BLANKS
MACHINED BRONZE PARTS

S & H Bronze Bearings are made of cast bronze, under the most modern conditions and of specifications to meet the most exacting requirements. We are manufacturers of plain bronze and graphited and oilless bronze bearings for all branches of the Government Services, as well as plain cylinder type, single and double flange, thrust washers, from ⅜" in diameter to 20" in diameter. We also manufacture special parts made of cast bronze. Our manufacturing methods and equipment enable us to meet the most exacting machining specifications.

If it's Bronze — BETTER B BEARINGS — *We make it*

INDUSTRIAL BEARINGS

S. & H. Bearing and Manufacturing Co.

340-344 North Avenue, East

Cranford New Jersey

PRICES

Ferromanganese

78-82% Mn, maximum contract base price per gross ton, lump size, f.o.b. car at Baltimore, Bethlehem, Philadelphia, New York, Birmingham, Rockdale, Rockwood, Tenn.

Carload lots (bulk)	$135.00
Carload lots (packed)	141.00
Less ton lots (packed)	148.50

$1.70 for each 1% above 82% Mn; penalty, $1.70 for each 1% below 78%.

Manganese Metal

Contract basis, lump size, per lb. of metal, f.o.b. shipping point with freight allowed. Spot sales add 2c. per lb.

96-98% Mn, .2% max. C, 1% max. Si, 2% max. Fe.

Carload, bulk	36c.
L.c.l. lots	38c.

95-97% Mn, .2% max. C, 1.5% max. Si, 2.5% max. Fe.

Carload, bulk	34c.
L.c.l. lots	35c.

Spiegeleisen

Maximum base, contract prices, per gross ton, lump, f.o.b. Palmerton, Pa.

	16-19% Mn 3% max. Si	19-21% Mn 3% max. Si
Carloads	$35.00	$36.00
Less ton	47.50	48.50

Electric Ferrosilicon

OPA maximum base price cents per lb. contained Si, lump size in carlots, f.o.b. shipping point with freight allowed.

	Eastern Zone	Central Zone	Western Zone
50% Si	6.65c.	7.10c.	7.25c.
75% Si	8.05c.	8.20c.	8.75c.
80-90% Si	8.90c.	9.05c.	9.55c.
90-95% Si	11.05c.	11.20c.	11.65c.

Spot sales add: 45c. per lb. for 50% Si, .3c. per lb. for 75% Si, .25c. per lb. for 80-90% and 90-95% Si.

Silvery Iron

(C/L, Per Gross Ton, base 6.00 to 6.50 Si)

F.o.b. Jackson, Ohio	$29.50*
Buffalo	30.75*

For each additional 0.50% silicon add $1 a ton. For each 0.50% manganese over 1% add 50c. a ton. Add $1 a ton for 0.75% phosphorous or over.

*OPA price established 6-24-41.

Bessemer Ferrosilicon

Prices are $1 a ton above silvery iron quotations of comparable analysis.

Silicon Metal

OPA maximum base price per lb. of contained Si, lump size, f.o.b. shipping point with freight allowed to destination, for l.c.l. above 2000 lb., packed. Add .25c. for spot sales.

	Eastern Zone	Central Zone	Western Zone
96% Si, 2% Fe	13.10c.	13.55c.	16.50c.
97% Si, 1% Fe	13.45c.	13.90c.	16.80c.

Ferrosilicon Briquets

OPA maximum base price per lb. of briquet, bulk, f.o.b. shipping point with freight allowed to destination. Approximately 40% Si. Add .25c. for spot sales.

	Eastern Zone	Central Zone	Western Zone
Carload, bulk	3.35c.	3.50c.	3.65c.
2000 lb.-carload	3.8c.	4.2c.	4.35c.

Silicomanganese

Contract basis lump size, per lb. of metal, f.o.b. shipping point with freight allowed. Add .25c. for spot sales. 65-70% Mn, 17-20% Si, 1.5% max. C.

Carload, bulk	6.05c.
2000 lb. to carload	6.70c.
Under 2000 lb.	6.90c.
Briquets, contract, basis carlots, bulk freight allowed, per lb.	5.80c.
2000 lb. to carload	6.30c.
Less ton lots	6.55c.

Ferrochrome

(65-72% Cr, 2% max. Si)

OPA maximum base contract prices per lb. of contained Cr, lump size in carload lots, f.o.b. shipping point, freight allowed to destination. Add .25c. per lb. contained Cr for spot sales.

	Eastern Zone	Central Zone	Western Zone
0.06% C	23.00c.	23.40c.	24.00c.
0.10% C	22.50c.	22.90c.	23.50c.
0.15% C	22.00c.	22.40c.	23.00c.
0.20% C	21.50c.	21.90c.	22.50c.
0.50% C	21.00c.	21.40c.	22.00c.
1.00% C	20.50c.	20.90c.	21.50c.
2.00% C	19.50c.	19.90c.	21.00c.
66-71% Cr, 4-10% C	13.00c.	13.40c.	14.00c.
62-66% Cr, 5-7% C	13.50c.	13.90c.	14.50c.

High-Nitrogen Ferrochrome

Low-carbon type: 67-72% Cr, 0.75% N. Add 2c. per lb. to regular low-carbon ferrochrome price schedule. Add 2c. for each additional 0.25% N. High-carbon type: 66-71% Cr, 4-5% C, 0.75% N. Add 5c. per lb. to regular high-carbon ferrochrome price schedule.

Low-Carbon Ferromanganese

Contract prices per lb. of manganese contained, lump size, f.o.b. shipping point, freight allowed to destination, Eastern Zone. Add 0.25c. for spot sales.

	Carloads, Bulk	Ton Lots	Less Ton
0.10% max. C, 1 or 2% max. Si	23.00c.	23.40c.	23.65c.
0.15% max. C, 1 or 2% max. Si	22.00c.	22.40c.	22.65c.
0.30% max. C, 1 or 2% max. Si	21.00c.	21.40c.	21.65c.
0.50% max. C, 1 or 2% max. Si	20.00c.	20.40c.	20.65c.
0.75% max. C, 7.00% max. Si	16.00c.	16.40c.	16.65c.

Ferrochrome Briquets

Contract prices per lb. of briquet, f.o.b. shipping point, freight allowed to destination. Approx. 60 per cent contained chromium. Add 0.25c. for spot sales.

	Eastern Zone	Central Zone	Western Zone
Carload, bulk	8.25c.	8.55c.	8.95c.
Ton lots	8.75c.	9.25c.	10.75c.
Less ton lots	9.00c.	9.50c.	11.00c.

Ferromanganese Briquets

Contract prices per lb. of briquet, f.o.b. shipping point, freight allowed to destination. Approx. 66 per cent contained manganese. Add 0.25c. for spot sales.

	Eastern Zone	Central Zone	Western Zone
Carload, bulk	6.05c.	6.30c.	6.60c.
Ton lots	6.55c.	7.55c.	8.55c.
Less ton lots	6.80c.	7.80c.	8.80c.

Calcium—Manganese—Silicon

Contract prices per lb. of alloy, lump size, f.o.b. shipping point, freight allowed to destination.

16-20% Ca, 14-18% Mn, 53-59% Si. Add 0.25c. for spot sales.

	Eastern Zone	Central Zone	Western Zone
Carloads	15.50c.	16.00c.	18.05c.
Ton lots	16.50c.	17.35c.	19.10c.
Less ton lots	17.00c.	17.85c.	19.60c.

Calcium Metal

Eastern zone contract prices per lb. of metal, f.o.b. shipping point, freight allowed to destination. Add 5c. for spot sales. Add 0.9c. for Central Zone; 0.49c. for Western Zone.

	Cast	Turnings	Distilled
Ton lots	$1.80	$2.30	$5.00
Less ton lots	2.30	2.80	5.75

Chromium—Copper

Contract price per lb. of alloy, f.o.b. Niagara Falls, freight allowed east of the Mississippi River. 8-11% Cr, 88-90% Cu, 1.00% max. Fe, 0.50% max. Si. Add 2c. for spot sales.

Shot or ingot ..... 45c.

Ferroboron

Contract prices per lb. of alloy, f.o.b. shipping point, freight allowed to destination. Add 5c. for spot sales. 17.50% min. B, 1.50% max. Si, 0.50% max. Al, 0.50% max. C.

	Eastern Zone	Central Zone	Western Zone
Ton lots	$1.20	$1.2075	$1.229
Less ton lots	1.30	1.3075	1.329

Manganese—Boron

Contract prices per lb. of alloy, f.o.b. shipping point, freight charges allowed. Add 5c. for spot sales.

75.00% Mn, 15-20% B, 5% max. Fe, 1.50% max. Si, 3.00% max. C.

	Eastern Zone	Central Zone	Western Zone
Ton lots	$1.89	$1.903	$1.935
Less ton lots	2.01	2.023	2.055

Nickel—Boron

Spot and contract prices per lb. of alloy, f.o.b. shipping point, freight allowed to destination.

15-18% B, 1.00% max. Al, 1.50% max. Si, 0.50% max. C, 3.00% max. Fe, balance Ni.

	Eastern Zone	Central Zone	Western Zone
11,200 lb. or more	$1.90	$1.9125	$1.9445
Ton lots	2.00	2.0125	2.0445
Less ton lots	2.10	2.1125	2.1445

Other Ferroalloys

Ferrotungsten, Standard grade, lump or ¼X down, packed, f.o.b. plant at Niagara Falls, New York, Washington, Pa., York, Pa., per lb. contained tungsten, 10,000 lb. or more $1.90

Ferrovanadium, 35-55%, contract basis, f.o.b. producer's plant, usual freight allowances, per lb. contained Va.

Open hearth	$2.70
Crucible	$2.80
Primos	$2.90

Cobalt, 97% min., keg packed, contract basis, f.o.b. producer's plant, usual freight allowances, per lb. of cobalt metal $1.50

Vanadium pentoxide, 88%-92% V_2O_5 technical grade, contract basis, any quantity, per lb. contained V_2O_5. Spot sales add 5c. per lb. contained V_2O_5 ..... $1.10

Ferroboron, contract basis, 17.50% min., Bo, f.o.b. producer's plant with usual freight allowances, per lb. of alloy.

2000 lb. to carload	$1.20
Under 2000 lb.	1.30

Silcaz No. 3, contract basis, f.o.b. producer's plant with usual freight allowances, per lb. of alloy. (Pending OPA approval)

Carload lots	25c.
2000 lb. to carload	26c.

Silvaz No. 3, contract basis, f.o.b. producer's plant with freight allowances, per lb. of alloy (Pending OPA approval)

Carload lots	58c.
2000 lb. to carload	59c.

Grainal, f.o.b. Bridgeville, Pa., freight allowed 50 lb. and over, max. based on rate to St. Louis

No. 1	87.5c.
No. 6	60c.
No. 79	45c.

Bortram, f.o.b. Niagara Falls

Ton lots, per lb.	45c.
Less ton lots, per lb.	50c.

Ferrocolumbium, 50-60%, contract basis, f.o.b. plant with freight allowances, per lb. contained Cb.

2000 lb. lots	$2.25
Under 2000 lb. lots	$2.30

Ferrotitanium, 40%-45%, 0.10%C. max. f.o.b. Niagara Falls, N. Y., ton lots, per lb. contained Ti .. $1.23
Less ton lots $1.25

Ferrotitanium, 20%-25%, 0.10%C. max., ton lots, per lb. contained titanium $1.35
Less ton lots $1.40

High-carbon ferrotitanium, 15%-20%, 6%-8% carbon, contract basis, f.o.b. Niagara Falls, N. Y., freight allowed East of Mississippi River, North of Baltimore and St. Louis, per carload $142.50

Ferrophosphorus, 18% electric or blast furnaces, f.o.b. Anniston, Ala., carlots, with $3 unitage freight equalled with Rockdale, Tenn., per gross ton $58.50

Ferrophosphorus, electrolytic 23-26%, carlots, f.o.b. Monsanto (Siglo), Tenn., $3 unitage freight equalized with Nashville, per gross ton $75.00

Ferromolybdenum, 55-75%, f.o.b. Langeloth, Washington, Pa., any quantity, per lb. contained Mo. 95c.

Calcium molybdate, 40%-45%, f.o.b. Langeloth and Washington, Pa., any quantity, per lb. contained Mo. ..... 80c.

Molybdenum oxide briquettes, 48%-52% Mo, f.o.b. Langeloth, Pa., per lb. contained Mo ..... 80c.

Molybdenum oxide, in cans, f.o.b. Langeloth and Washington, Pa., per lb. contained Mo ..... 80c.

Zirconium, 35-40%, contract basis, f.o.b. producer's plant with freight allowances, per lb. of alloy. Add ¼c. for spot sales
Carload lots ..... 14c.

Zirconium, 12-15%, contract basis, lump f.o.b. plant usual freight allowances, per lb. of alloy
Carload, bulk ..... 4.6c.

Alsifer (approx. 20% Al, 40% Si and 40% Fe), contract basis, f.o.b. Niagara Falls, carload, bulk ..... 5.75c.
Ton lots ..... 7.25c.

Simanal (approx. 20% Si, 20% Mn, 20% Al), contract basis, f.o.b. Philo, Ohio, with freight not to exceed St. Louis rate allowed, per lb.
Car lots ..... 8.75c.
Ton lots ..... 9.25c.

YOUR cleaning problem is an individual one. It must be approached as such, analyzed and carefully considered in the light of experience on similar problems of others. Because our engineers treat your problem individually, and because the American line of Metal Washing Machines has been designed to combine the required operations into economical units high savings can be achieved.

New techniques and principles of design and construction employed by the American line of Metal Washing Machines bring you an entirely new method for handling your specific washing problems. Each new feature (*pat. applied for) has allowed many manufacturers to speed up operations and cut rejects to new minimums.

No part is too large, too small, or too intricate to be efficiently cleaned by one of the many types and sizes of American Metal Washing Machines. If you have a metal washing problem that isn't being solved to your entire satisfaction, write us and tell us about it. Our engineers will be glad to give you every possible help.

Below is a partial list of users who found the new methods employed by American's engineers in their line of Metal Washing Machines to be a profitable investment.

A FEW USERS ★
Curtiss-Wright
Dodge-Chicago
Elastic-Stop Nut
Electric Auto-Lite
Parish Pressed Steel
Union Parts
Wesley Steel Treating
★ and many others

Made by the Manufacturers of Wheelabrator

American
FOUNDRY EQUIPMENT CO.

510 S. Byrkit St., Mishawaka, Indiana

ANOTHER NEW SERVICE BY "CARBORUNDUM"

THE GRINDING WHEEL THAT SPEAKS FOR ITSELF!

MORE THAN A LABEL, THIS NEW BLOTTER TELLS THE WHOLE STORY AT A GLANCE!

From now on, it's going to be easier than ever to pick the right wheel for the job—all grinding wheels by "CARBORUNDUM" will carry this new wheel blotter . . . makes identification *quicker* and easier. A glance tells you why.

1 **Easier to use.** All the information you need is on one side of the blotter (see large picture opposite page). And to make it even easier to pick the correct grading, it lists both the old wheel markings and the new markings.

2 **Easier to recognize.** The bright red color says it's a wheel by "CARBORUNDUM", clear across the shop! It's further identified by the display side of the blotter. (See small picture opposite.) Even when the wheel is mounted on the machine, and the blotter is covered, the little black mark on the blotter margin identifies it as a product by "CARBORUNDUM".

3 **Easier to read.** The new blotter resists scuffing, and the heavily inked surface remains more legible, even when soiled with grime and grease.

Wheels with the new blotters will be shipped shortly. If you should receive a wheel with the old blotter, it just means that particular wheel was stocked before the new blotters were ready.

THERE IS A PRODUCT BY

CARBORUNDUM

TRADE MARK

FOR EVERY ABRASIVE APPLICATION

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